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Devoted to Civil Engineering and Contracting. McGraw-Hill Company, Inc

January 8, 1925

Engineering News-Record

A Year's Progress In Engineering and Construction

In this issue:

What's What in Engineering

Outstanding developments during the year just closed and their significance in the year now starting—A review by the editors.

What is the Problem of the Colorado

An unbiased statement of the engineering fundamentals of the control and utilization of this great national resource.

How Are We Going to Finance Our Roads?

A review of the latest thinking on this most important national problem.

Railway and Marine Terminals

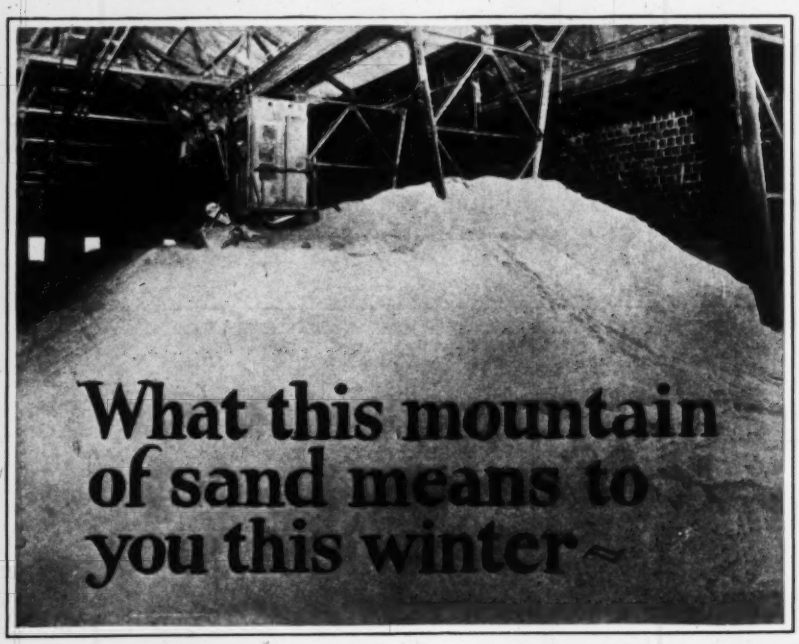
A short description of the details of the numerous engineering projects now under way looking toward the more economic distribution of freight.

And

Engineering News-Record Annual Statistics of the Construction Industry

Which includes

A New Table of Index Numbers of Construction Volume—Outlook for Labor Rates and Employment; Trends in 20 Cities—Spring Prices of Construction Materials Since 1913—Price Outlook for Materials—E. N.-R. Construction Cost Index; Derivation and Values—Value of 1924 Contracts Breaks All Records



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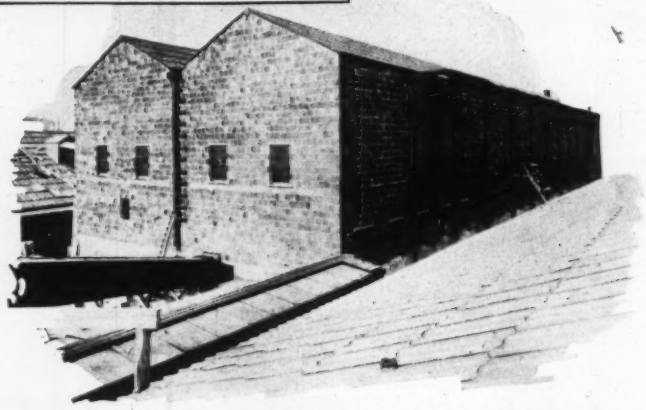

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ENGINEERING NEWS-RECORD

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

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Editor

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The Plan of This Issue

PROGRESS in any art, industry or science cannot be marked off in calendar years, but such arbitrary time divisions are convenient measuring points at the end of which stock can be taken. This issue of *Engineering News-Record* has been prepared with that purpose in view. Following a review of the developments in engineering and construction as they have come under the purview of the editors, there are several major articles on some of the outstanding engineering problems of today, a photographic presentation of the important constructions of the past year and the annual review of the volume of construction—that visible evidence of the engineer's work—as that volume has been reported in these pages. Because engineering ebbs and flows with the general state of industry and world economics, the salient features of that important phase of world life starts the editorial review.

Tempered Optimism

IN NO new year in the past decade has business looked so promising. Production has become stabilized, the farmer has had a good year, those who would work can, the major issues of national politics have been fixed for a while by the November election, foreign affairs are moving slowly away from the war chaos and the most of our people are cheerful and optimistic. These are the indicia of prosperity. Similar indicia a few years ago would have presaged boom times and boom times mean an early depression. Whether or not there is such a thing as a business cycle—that is a more-or-less orderly curve of recurring prosperity and depression—it is certain that the indexes of prosperity cannot continue indefinitely to go up and that a too sudden rise means a too sudden fall. Warned by the troublous summer of 1920 the business man of this country has become aware of the danger of such a sudden rise; he is fearful of too great confidence in the immediate future, he has come to realize that universal production to meet anticipated demand soon results in overproduction and, what is more important, he is more reluctant to gamble on the possibility that he himself is going to be the only one to rush ahead of the crowd to gain the advantage assured the single overproducer in an undersupplied market.

In short, all the elements in industry are today making a closer study of the basic factors in national economics and are provided with more knowledge of these basic factors than ever before, so that while we enter 1925 with all things set for prosperity, we also enter a road marked with every possible warning sign that too much prosperity means riding to a fall. In a situation as basically sound as is the economic structure of the United States this cautiousness is the best armor against trouble.

Major Economic Factors

WHAT is the situation in the major elements that contribute to prosperity? In industry we have had a year not quite so active as in 1923 but sufficiently active to be satisfactory. Whether because of the uncertainties of the presidential election or because of the operation of this newly born group fear of too sudden prosperity, there was a sharp depression in the summer, reflected mainly in the steel and textile industries, but this depression was safely passed over and the new year approached with a return to satisfactory production. Wages uniformly remained high and prices fairly stable so that the real wage of the worker (that is the relation of income to necessary outgo) remained about as it was, slightly higher than it was before the war, but by no means as much higher as the actual wage figures would indicate. Standards of living continually rise, too, so that the definition of the word "necessary" as applied to outgo must be elastic. In spite of reduced production in some lines, with consequent layoffs of labor, the wage scale was maintained. The general condition of labor continued good, and labor itself refused to be stampeded in the election into radical policies that promised greater reward.

There is nothing in sight now which would indicate the reduction of either nominal or real wages and any consideration of future economic development must be predicated on that fact. It may be that some day wages as well as prices will take the downward trend that has always been noted from 10 to 15 years after a great war, but there is no avoiding the fact that social conditions today are different than they were in the world after Napoleon or in the States after the Civil War and that the working man is demanding and the world is giving him a greater share in the world's comforts than ever before. Unless we have a social revolution this is not apt to change, which means a stability of the high wage scale never before known, and a high wage scale means a continuation of the price situation in statu quo.

In 1924 the farmer came into his own. Farming is by no means the bonanza that the cartoonists have been picturing, nor have many individual farmers become rich in the past twelve months, but farm products prices are approaching the fair basis of an index comparable to that of the commodity prices, and production has been high. The farmer, taken by and large, is happier than a year ago and that means much to our national life.

Foreign trade continues to increase, slowly. It is encouraging, particularly, to note that in 1924 our exports to Latin America were greater than ever before in our history. There is every reason to hope that the racial and lingual barrier with our Southern neighbors is breaking down under the continued pressure of friendliness and fair business dealing.

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Political Elements

THE European muddle moves but slowly toward solution. By the efforts of Americans the greatest single step ahead since 1918 was made in the preparation and acceptance of the Dawes plan. This economic machine, conceived and fabricated outside the political atmosphere of hatred and selfishness, was adopted by Europe because there was no other way out. Since its acceptance there have been waverings in the chancelleries, the treaty of Versailles is invoked wherever there seems to be danger of a national advantage being attacked, the forlorn hope of the repudiation of the debt to America is brought out and dangled before the eyes of a burdened electorate in moments of political need—but all this is the last struggle of the separate European governments to avoid the plain necessities of the war, a recurring spark of the dream that possibly after all there is some way out other than that indicated by the Dawes Commission, some way by which everyone in Europe, at least, will be happy and no one will pay.

There is no prospect of any change in national policies that will affect business in the coming year. The President evidently takes his election as a mandate from the people to refrain from reform and to insist on economy. Taxes, the people believe, must be reduced. Unfortunately only a small part of our tax burden is due to the extravagances of our national government and it is only that part that the Coolidge administration can directly control. It can, however, do by precept and example what it cannot do by order and there is every indication that the President's gospel of economy has caught the popular mind and will thereby be reflected to the administrators of the minor political subdivisions.

Construction Prospects

IN SPITE of the mid-year depression and the presidential election 1924 was the record construction year. When 1923 surpassed all records for construction it seemed impossible that the new year could reach the enormous sum of $6,000,000,000 for all manner of building in the United States and in our forecast of a year ago we discounted the possibility of another record. But as the statistics elsewhere in this issue shows, the grand total for 1924 was nearly a half-billion above 1923 and the large contracts—which is the class recorded by this journal—totaled $2,002,533,000 as against $1,899,254,000 for 1923. Further than that the total for December is the highest on record for that month, showing that the new year is entered on a rising rather than a falling tide of construction. Taken with the other favorable factors this would indicate another good construction year.

The popular view of construction is that there is still a vast deficit from the war yet to be made up. This is not true, except as it applies to residential building, about a third of the total construction. And there are even signs that residential building, with its greater demands due to the rising living standard, is nearing saturation or at least normal increase. Commercial building, on the other hand, never had a post-war deficit, but rather a surplus. The half-billion dollars which went into new factories and power developments in 1924 should therefore indicate normal work. The war did cause a deficit in public works, which the various government agencies are striving to make up, but in doing so they are confronted with an equally imperative demand to reduce public expense. The indications are at present that this latter demand is going to prove so strong that a falling off in public work expenditure will be noted. But even with such a falling off the coming year should follow the one just passed in being for engineers and contractors alike one in which there will be no scarcity of work.

Contracting Progress

CONTRACTORS have much to content them in the activities of 1924. It was on the whole a good year for construction. Transportation and weather conditions, wages and prices ran about true to form and there was perhaps less underbidding than has been usual. And there was plenty of construction. Woe was not lacking, particularly in contracting for road work but it was no greater and may be a little less than the road builder has learned to endure. Activities of broader import by the industry as a whole present a similar aspect. In the matter of the war contract fraud charges the contractors have received favorable action in every decision rendered by the courts. The courts too have upheld the contractors in claiming damages for misleading data given by engineers, as in the instance of the Passaic valley sewer tunnel contracts. All these legal activities have been discussed and are fresh in mind. So also is the work of the joint conference on uniform contracts. Here contracting secured an enormous gain in having arbitration recognized as a fundamental principal of all construction contracts. In the vital matters of contract bonding reforms and in its contention against day labor, contracting, however, has scored something of a failure. As the outcome of a year's activities possibly a better understanding of the matters in dispute has been arrived at but certainly the constructive results have been meager. In these matters contracting as yet has not found itself—is not certain of what it wants and why it should have it. This is an understanding which should be striven after in the present year.

Construction Equipment

IN THE field of machinery and materials used in construction during 1924, the march of progress was along two major routes. First, that of simplification by eliminating needless or little used varieties and second, that of improvement in mechanical details.

With the result previously achieved in the paving brick industry as an example of how 66 varieties were cut to 4, other manufacturers embarked on waste elimination programs in their own industries. The asphalt producers made effective at the beginning of 1924 a scale of 10 standard grades, determined by the penetration test, covering both asphalt mixtures and filler. Other substantial reductions in variety were made by makers of steel reinforcing bars, concrete blocks, hollow tile products, lumber, face brick, metal lath—to mention a few of the leading materials.

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In machinery, as distinguished from materials, the longest stride for simplification was taken by the concrete-mixer manufacturers, who, in co-operation with the Associated General Contractors, established as standard three sizes of paver.

The needs of construction have been met for so many years by such a variety of machines that nothing fundamentally new as to type can be said to have made its first appearance during 1924. However, there have been many changes in design and new adaptations of standard machines. The Diesel engine as the power equipment for the "steam" shovel is gaining ground. The manufacturer who first announced this feature now makes three sizes of revolving shovel with this kind of power, and just before the close of the year a second maker announced a Diesel shovel.

Crawler mountings for shovels, cranes, mixers and other machines have long since passed from the stage of novelty to that of proved utility, even on such ponderous machines as the big railroad type shovel. The mixer manufacturers have altered designs to reduce the time of charging and discharging, thus increasing capacity in batches per hour without shortening the actual mixing time. Larger inlet and outlet openings, speedier hoisting and steeper slopes for the skips are among the features that have contributed to speeding the batch in and out of the drum.

On the smaller mixers, a number of trailer types have been developed for quick movement from job to job. Many refinements in mechanical details have been incorporated into these small-sized machines. We now have models, for example, with steel disk wheels, solid rubber or pneumatic tires, roller or ball bearings, and spring mountings.

The ever-increasing congestion of traffic on rural highways and city streets has led to the wider use of traffic guide lines and the development of a number of new machines for applying paint or integral guide lines to road surfaces. The increasing demand for roads usable throughout the year has been responsible, also, for the development of a number of new types of snow plow. These range all the way from straight blades for attachment to trucks or tractors to large V-shaped moldboards supplemented with adjustable side wings, capable of clearing a road 18 ft. or more in width at one operation. Some special forms of equipment also have been developed to adapt a standard type of elevating loader to the handling of snow.

In the road grader field, a number of refinements have been introduced in the form of spring lifts, steerable engine tongues for tractor operation and roller bearings. Many graders have been incorporated with a Fordson tractor to form a single unit. This type of tractor has also been widely adopted as the power plant for other forms of equipment, including hoists, shovels, compressors, pumps, street sweepers, loaders, saw rings, and light cranes.

In their later designs of construction equipment, the manufacturers have been extending the use of alloy steels, anti-friction bearings, forced feed lubrication instead of grease cups, and other features designed to lengthen the life and improve the service of their machines.

Highway Development

THERE has been no diminution of highway activities in 1924. Something over ten thousand miles have been added to the improved road system of the country. The flow of expenditure toward maintenance has gained volume. In no respect did the public demand for roads decrease, but there was an evident disposition to plunge less carelessly into wholesale financing and to take stock of and appraise present taxation methods in view of future operations. There were no outstanding developments in highway design. The findings of the Bates road and other tests of 1922-23 were carried somewhat farther in practice, but the year's investigations only added evidence to strengthen the previous conclusions. There was, however, a marked encouragement of research into problems of road operation and highway transport. Taxation practice, safety of road structure, density and character of traffic, vehicle operation economics, snow removal, dust prevention and maintenance practice generally have all been subjects of elaborate investigation and intensive study. The understanding that the ultimate highway problem is an operating problem has grown greatly during the last year. It seems certain that the trend which highway activity took in 1924 will continue through the present year. There will be some ten thousand miles of improved road added to the country's highway system. There will be about a billion dollars spent in construction and maintenance. In brief public roads activities in the United States have arrived at the status of a continuing business.

Bridge Construction

A MARKED change has come about from the stagnation in bridge construction that characterized the war and early post-war periods. Quite a few notable enterprises have been initiated, though including little railway work. Most of the new work represents the accumulated need for highway interconnection where great rivers cut across the country. Prominent among the works in progress during the year are the Carquinez Straits bridge, eight or nine crossings of the Missouri River in the Dakota and Missouri regions, several important connections in the coastal plains region of the South Atlantic, the Tampa-St. Petersburg transbay highway, the great Delaware River bridge at Philadelphia, two bridges over the Hudson, and several important bridges in Pittsburgh, one just completed and three more ready for the start of construction. The Hudson River bridges include the costly New York Central crossing at Castleton and the suspension toll-bridge at Bear Mountain. Evidently the profitableness of bridge building is coming to be appreciated by the taxpayers, and to a slight extent also by investors. With such recognition, it seems certain that much additional large bridge work will be carried out in the near future, as highway interconnection needs are still very far from being met.

Abroad, the two events of greatest interest in this field were the construction of a large eyebar suspension bridge in Brazil (not yet completed) and the award of a contract, after twenty-five years of calling for bids and changing plans, for the Sydney Harbor bridge in Australia. The latter work was let to a British firm, as the result of a design-and-bid competition in which a score or so of plans were submitted. The accepted

design is for an arch of 1,650-ft. span modeled closely after Lindenthal's Hell Gate arch. The successful bid was substantially the lowest, but unfortunately nothing can be learned from the result as to the intrinsic merits of the several designs, since tariff preferences and other factors hopelessly unbalanced the comparison. Relatively more ought to be learned from the execution of the work, as the great length and weight of the arch span will make it a most difficult undertaking.

It is noteworthy that with this increased activity a definite progress in bridge engineering thought is evident. The Florianopolis and Sydney Harbor bridges typify this in respect to design forms and magnitude. In another direction there is great significance in the departure from previously current views made in the design of the three new Allegheny River bridges at Pittsburgh, where a "self-anchoring" suspension type, with plate-girder stiffening and compression member, was adopted. The design follows closely that of the Cologne bridge in Europe, built during the war. While most of the large bridges under construction or in course of planning still hold very close to conventional practice, there are thus clear signs of a freer and untrammeled current of thought. This appears to mark the beginning of a new era in bridge engineering development. We may look in the future to a greater readiness to accept theoretical complication of structure than could be found at any time within the past quarter century. For the present it would be idle to speculate more fully on what this change means. Its further progress should be worth careful study.

What was done during the year in the subject of bridge specifications may or may not represent progress. Strong efforts were made to reach agreement between different engineering groups upon standard specifications for railway and highway bridges respectively. The conferences, however, developed personal and group antagonisms contrasting curiously with the strictly technical purpose of the work. Possibly the result is to be welcomed, however, for it is questionable whether an operation depending upon engineering ability and trained judgment to so high a degree as bridge design ought to be fettered by specifications branded "American Standard." It seems that for some years we have been drifting along in the current of standardization, usually with the term "engineering" hovering around on the outskirts, and have given no consideration to the inherent impossibility of confining either creative thought or the art of the engineer by codes of rules. Possibly the dispute about bridge specifications may be the means of bringing this point to proper recognition.

Cement

CEMENT production for 1924 will probably total around 148,000,000 bbl., as against the record of 137,460,000 bbl. for 1923. The increase is not quite that set by the previous year when it amounted to 18 per cent, but in that year the increase in all construction was 22 per cent. From 1923 to 1924 the cement use increased just about the same as general construction, that is about 8½ per cent, which would indicate that not only is there more construction, which necessarily requires more cement, but that more of the total construction is using cement.

This increase in use has been interwoven with the

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spread of knowledge about concrete. The more people that use cement the more will know how to use it and the more information there is spread about its use the more there will be who will want to use it. The manufacturers some years ago sensed this and went into the business of acquiring and spreading information on a grand scale. The results have justified the efforts and expense; the work of the Portland Cement Association has been an important factor in the improvement of concrete and consequently, by the thesis set forth above, in the increased use of cement. In the past year the manufacturers went ahead another step by helping to finance and direct a joint study with the government into the nature of cement. This is a long-time work but it will surely justify itself in better cements.

Meanwhile the so-called improved cements are beginning to interest the user and worry the manufacturer. The long contention that one cement and only one can be profitably made and marketed is going by the board. A leading company is already making and selling three different types of cement, adapted for different kinds of uses, and the manufacturers are all studying, some furtively some openly, the possibilities offered in the closer attention to mill details required to produce a high early strength cement that possesses all the wearing qualities of standard portland. The obvious necessity to reduce manufacturing detail to the simplest which will produce a safe and economical cement and the equally obvious merchandising advantages of having one standard for selling cement from coast to coast, regardless of how much any particular cement may rise above that standard, continue to cause the cement manufacturer to be wary of any change—but the past year, with its continuation of expressed curiosity by engineers as to the possibility of better cement, has marked quite a change in the manufacturer's attitude. We are at the beginning of a revolution, of a sort, in the cement industry.

Concrete

IN CONCRETE itself the year saw the completion of the final report of the Joint Committee on Concrete and Reinforced Concrete, with its standard specifications for design and construction. Probably because this final report was changed but little from the tentative specifications which were submitted two years before, the final report did not receive much attention either from the societies or from concrete users in general. And yet it is one of the most important documents in the structural field, mainly because it will become, as did its predecessor, the standard by which all except the most independent of engineers will measure the design of concrete. The revised document, despite the neglect it has been subjected to, is an admirable exposition of the current knowledge of concrete, and has been bettered materially by the removal of some of the contentious material which was put in the tentative document, possibly merely as a basis of argument. No work of 25 experts is perfect or acceptable *in toto* to any one of them; the Joint Committee report is no exception to the rule.

No special progress in either design or construction

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in concrete marked the year. There were the usual number of structures but none of them especially epoch making either in size or detail. There was, however, more consistent effort made to study and apply the proper rules for the proportioning of the concrete mix than ever before. In the published data in this field we are marking time. The students of the various proposals to guarantee a better concrete through more rational proportioning have published no new material, but more men are applying the rules already advanced and thereby learning their benefits and deficiencies.

It may be too early to make definite announcement of a change of spirit along this line, but there are indications which warrant a venture toward the prediction that a great simplification is due in this whole matter of proportioning. There are those who believe that, within certain limits of sizes which would not be apt to occur or to be proposed, any grading or proportioning of aggregate can be used provided the cement-water ratio is correct and the mixture workable, according to the trained eye of the expert concrete man. So radical a specification as this was proposed for one of our largest structures last year by an engineer well qualified to take responsibility for such a structure and, although rejected by the more conservative engineers in charge, the method was used in effect on some of the work with great success. The result of this kind of thinking is that there may be some advantage in economy in analyzing aggregate for size but that strength is a function of water and workability. It looks as though we are approaching the prediction made some years ago that there is some simple basic relation which experimenters are moving toward in all the complication of cement ratio, fineness modulus, surface area and void ratio, which will eventually be found and that when found the making of concrete will return to the simplicity of the older days with a guarantee of effective strength and behavior that by no means accompanied that earlier simplicity.

Railroad Progress

MEASURED in terms of traffic alone, the past year has not been as successful for the railroads as was the year 1923, but measured in almost any other terms it has been a better one. Improved facilities and a large amount of new equipment have made it possible for them to surpass ten of the records for efficient operation established in past years, and easier money has made possible the placing of still larger orders for new cars and locomotives and the building of more new track. Relations between the companies and their employees have been unusually good during the year, and relations with the shippers have continued to improve through the setting up of more Shippers Regional Advisory Boards.

In the field of new construction, the year 1924, for the first time since 1916, saw an excess of new construction authorized by the Interstate Commerce Commission over lines abandoned. The new year opened with a number of projects either already under way or approaching active construction; the Seaboard Air Line's new 238-mile railroad across Florida, the Southern Pacific 118-mile cutoff in Oregon and the Union Pacific's new 98-mile line in Idaho and Nevada are among the larger ones.

In freight yard and terminal facilities the railroads have generally lagged behind the growth of traffic, so that these points have been a marked cause of delay and cost in the movement of freight, but there is now widespread activity in endeavors to cope with the situation and to provide facilities adequate for the present and even a future growth in traffic. For several years the backward condition was aggravated by the interruption of improvement work due to the World War, by the subsequent great increase in traffic, and by the railroads' financial and other difficulties.

Locomotives have been much to the fore in the year in the matter of new types. In steam locomotives the three-cylinder locomotive, after years of being in the discard in this country, has suddenly returned to favor. At least four railroads are now building locomotives of this type. An entirely new departure is the high-pressure steam locomotive put into service by the Delaware & Hudson R.R. which uses a boiler pressure of 350 lb. as opposed to the pressure of 200 lb. now in general use. New types of electric locomotives include two in which alternating current supplied by the feed wire is converted to direct current on the locomotive itself, and one in which electricity is produced on the locomotive by an internal combustion oil engine. In the case of one of the two former types, alternating current will be supplied at 22,000 volts, or about twice as high a voltage as has been used heretofore.

The use of self-contained motor cars on branch lines has increased rapidly during the year and the further extension of their use bids fair to save many a branch line from abandonment. Still, abandonment continues. During the year the Interstate Commerce Commission authorized the scrapping and sale of 453 miles.

Electrification of a surprisingly large amount (400 miles) was undertaken during the year, and there is every indication that there will be more in 1925.

Engineering in the Cities

IN QUANTITY and quality good progress was made throughout the municipal field in 1924. Innovations were notably absent, due in part to previous advances in design, in choice and treatment of material, and in the increased use of power-driven machinery for construction work. Judged by the "contracts let" recorded weekly in our Construction News Section and the yearly summaries based on them there was a normal increase in the volume of municipal work done in 1924. Waterworks fell off a trifle; sewerage construction gained a considerable percentage; city paving apparently increased materially in volume but this is uncertain as in the records it is hard to distinguish streets from roads. Changes in the framework of city government included the going into effect Jan. 1 of a commission-manager charter for Cleveland, Ohio, which is by far the largest city to come under that plan. A manager for Kansas City, Mo., was included in a new charter adopted late in the year while at Cincinnati and Minneapolis a manager is proposed in new charters yet to be voted on. In striking contrast to charter simplification and clear-cut separation of executive from legislative functions, Los Angeles adopted a complicated charter with much decentralization and mixing of powers.

Water Purification

ADVANCES in water purification lie in new plants and enlargements to old rather than in the art itself. Buffalo has treatment works well under way. Baltimore and Washington are building additional filters. New plants were completed at Richmond, Memphis, Wheeling and various other places in 1924. The Memphis plant is doubly notable because (1) that city is the largest (172,000 in 1920) in the United States depending on an underground source, a new system of wells having been put down in preference to abandoning wells for a surface supply, and (2) because in the purification works the air-lift, aërators, mechanical filters and chlorinators are used to remove iron, carbon dioxide, hydrogen sulphide and bacteria.

For many years after the advent of filtration in this country few large cities adopted the process. First gradually, then with relative rapidity, larger and larger cities built purification works. Today, roughly, half of the 69 cities which in 1920 had populations of 100,000 or more have filtration plants treating all or nearly all the water consumed and most of those without filters chlorinate the water supply. Moreover, a considerable percentage of the cities with unfiltered supplies draw their water from sparely populated mountain gathering grounds while some of the others—especially Chicago and Milwaukee—have spent and are spending vast sums on sewage disposal projects designed primarily for water-supply protection.

Sewage and Refuse Disposal

IN SEWAGE treatment, as was long true of water purification, the larger cities of the country have been relatively backward. Hardly a dozen of the 69 cities of over 100,000 population have yet built or begun to build comprehensive sewage-works. New York City is adding to its fine screening plants at points of worst nuisance; Chicago, Philadelphia and Cleveland are proceeding with their comprehensive programs, already partly executed; Los Angeles is carrying out its fine screening program; the Milwaukee and Indianapolis activated-sludge plants—the largest in the world—are being pressed on towards completion; Newark and the adjacent communities, through the Passaic Valley Sewerage District, placed settling basins and a multiple tidewater outlet in use the latter part of 1924, while during the year many smaller places completed or started sewage-works.

Numerically, additions to the fine screening plants completed or contracted for was perhaps the feature of the year, but the initiated will understand that these afford only partial treatment, which, however, may be sufficient at the outset and may as a rule serve later on as a useful preliminary to whatever more complete system may be adopted. Nevertheless, it is significant that fine screens are rapidly gaining ground.

Most engineers seem to be awaiting every day working tests of the Milwaukee and Indianapolis plants before recommending the activated-sludge process, although there are already a fair number of plants of the kind in the United States and many more, relatively, in Canada. The adoption of the activated-sludge process by Mamaroneck, N. Y., on the recommendation of an eminent consulting engineer, is significant because it is the first break of the kind into the Northeast.

Taking into account the conservatism of Great Britain, the activated-sludge process is perhaps making more rapid process there than in the United States.

Garbage and refuse disposal showed no material changes in 1924 in the various methods in use beyond a continuation abroad of sorting, screening and shredding of mixed refuse for purposes of salvage and to reduce the volume of non-combustibles sent to the destructors. In America, incineration seems to be gaining in favor as against reduction or hog feeding where new works are under way but most of the larger plants now being built were started or determined on before 1924. Not a single new reduction plant was started in 1924 and preliminary work on a plant of this type for Cleveland was stopped soon after the city manager plan of government went into effect on Jan. 1. What will be done finally has not yet been determined.

Pavements, Traffic and Transit

CITY pavements, traffic regulation and transit facilities combined make up the major part of the engineering problems and expenditures of our cities. A large percentage of the city street mileage of the country has never yet been adequately paved and much that has been paved is so badly in need of repairs as to demand early reconstruction. Huge sums for new work and repairs were expended during 1924, as in earlier years, and future demands will continue high. Heavier foundations to meet the growing volume and weight of traffic is the principal change to be noted in paving work.

Traffic control through the police and such well known accessories as signal towers are becoming so much in evidence as to entail large salary and other outlays while it is a small hamlet that cannot show at least one traffic "cop." That traffic regulation, necessary as it is and will continue to be, does not get at the root of congestion is becoming understood by the average citizen and city father, as it has long been by the engineer. As a result, street widenings, elimination of cul de sacs, easing of corners at street intersections, are gaining in number. Where real thoroughfares or major traffic streets already exist they are being duplicated or still further multiplied. Detours around congested districts and by-passes around whole cities are being provided. Bridges are being paralleled and tunnels built. In such cases as the New York-Jersey City vehicle tunnel and the Philadelphia-Camden bridge the necessary radiating thoroughfares at either end bid fair to equal or exceed the cost of the main structures.

The traffic problem does not stop at the city line. It is rapidly becoming state and interstate in character and eventually is bound to be so recognized. Meanwhile the need for regional planning has led to the creation of metropolitan and regional associations and committees in widely scattered parts of the country—as at New York, Philadelphia, Los Angeles, the Twin Cities in Minnesota, Chicago, and very recently the Buffalo Frontier and the Capital District Committees in New York State. These regional associations, as may be expected of state and interstate planning later on, propose to carry city zoning principles into their larger fields.

The Engineering Year

In Review and Prospect

From pavements, traffic and major streets to city transit is a natural step. Passing over the few American municipal ventures in ordinary street railway construction and operation, notably at Detroit, a few words may be said about what has become known as "subway" or rapid transit construction at municipal expense. Much as there is of this that has been discussed in emulation of the achievements of New York and Boston, the chief advance of the past year in terms of construction was the letting of nearly $28,000,000 worth of contracts for some 19,000 ft. of the four-track Broad St. subway in Philadelphia, comprising about two-thirds of the mileage proposed for this route and at Boston the initiation of a short but complicated extension of subway as well as the incorporation into the Boston rapid transit system of some of the surface trackage of the N. Y., N. H. and H. Ry. In New York City a political deadlock continued to hold up nearly all the work projected but there are indications that this will be broken in 1925.

Waterways

EXCEPT for the reconstruction of the Chesapeake & Delaware canal, the lock and dam construction on the Ohio and Monongahela Rivers, and the flood control work on the Mississippi, there has been little activity in the development of inland waterways during the year. The Chesapeake & Delaware canal work is nearing completion, and the Ohio River work is more than half done, while the Monongahela River work is less than half done. No measure can be set up for the Mississippi work, as it is but a carrying-on of the continual fight to keep the river within reasonable bounds.

There has been expended a considerable amount of money upon harbors and channels, but it was used largely for improving existing facilities rather than for new work. Proposed government work includes an elaborate scheme for the improvement of Los Angeles harbor to take care of the enormous traffic that now goes through that port. Local schemes for providing ship and rail accommodations at the ports and inland harbors to keep pace with government projects are numerous and comprehensive. Several cities are considering bond issues for marine terminals and others have voted money for municipal accommodations in addition to those provided by commercial concerns. The most recent project of this kind to start actual construction is the state-financed port development at Mobile, Alabama.

Efforts to stimulate traffic in existing inland waterways continue to meet with little success. Nevertheless the advisory board of the Inland Waterways Corporation optimistically tells the Secretary of War that the Mississippi and Warrior barge systems can be made paying propositions by the expenditure of five million dollars for light-draft and other barges, and recommends further proceedings to determine fair and equitable joint rail-and-water rates in order to aid the traffic, and the 28 consulting engineers who just passed on the Chicago diversion take occasion to commend the Lakes-to-Gulf waterway.

No one has as yet offered any solution to the dilemma of the waterway—that no one will put money into a reliable continuous carrier until there is some business and there can be no business until there is a reliable continuous carrier.

Water Power Developments

THE lack of spectacular hydro-electric developments during the year makes it appear as if there had been a falling off in the work of harnessing our water powers, but when the projects are set down together, as they are elsewhere in this issue, it becomes evident that such is not the case. The actual situation is that almost every important power company has been busy on one or more new plants, many of them small but in the aggregate they make a large amount of new power. The only very large plants to be completed were the new one of the Niagara Falls Power Co. and the La Gabelle plant in Canada, but the year 1925 will see the completion of the plants at Mocassin Creek, Pit River No. 3, and Muscle Shoals, and in Canada 120,000-hp. additional in the Queenston-Chippawa plant, the first units in the Isle Maligne plant, and 118,000 hp. in the Humberarm development in Newfoundland.

Most of the projects under way or to be started in this country are built under Federal Power Commission licenses. The number of applications for such licenses or permits is now well over 500. During the commission's past fiscal year it granted 64 and rejected 54 applications.

New features in water-power development include the highest head reaction turbine ever built—the 35,000-hp. turbine in the Oak Grove plant of the Portland Railway, Light & Power Co.—designed to operate under a head of 857 ft. The use of high-speed propeller-type turbine runners has been extended during the year and auxiliary features developed. Their application to low-head plants has been found very advantageous, the lowest head being that of 8 ft. in five 800-hp. units for the Illinois Northern Utilities Co.

Colorado River

EARLY this year the exhaustive Weymouth report on the problems of the Colorado River was completed. It promises to remain for a long time the most complete source of data on the subject, and though it has not yet been published we hope that Congress will provide the means for printing it. Just before the completion of that report, a joint engineering board chosen from government circles considered the entire Colorado subject. This furnished a brilliant opportunity for speeding the solution of the problem by placing the engineering aspects of the subject on a clear basis of fact. Unfortunately, the board missed its opportunities and arrived at what amounts to a disagreement. Unimportant details and broad policy questions might well have been left to one side in the endeavor to clear up the major physical questions. It makes little difference to the ultimate solution of the question whether the mean river flow is slightly greater or slightly smaller, or whether or not we have enough data for all-time estimates of river conditions. Again, the engineering study of the problem is not dependent on whether two men differ on power or storage policies. Regardless of the work of the board, however, it should be said that so many factors and interests operated to block progress

in the Colorado River matter that no definite progress has been made. Arizona has continued in its refual to ratify the interstate compact on water apportionment, and the Swing-Johnson bill for construction of the Boulder Canyon control project has failed to advance against strong opposition. In hearings on the bill the weaknesses of the compact were fully discussed, however, and it now seems doubtful whether ratification of the compact would help or hinder in final disposition of the questions of the Colorado River.

Inevitably every great problem becomes enmeshed in partisan contentions that the underlying facts are lost from view. The ordinary citizen in particular is at a great disadvantage in understanding the situation. The Colorado problem pre-eminently has become a fighting ground for attitudes and opinions based on interest, and the definite physical facts at the bottom of it are hard to find, and once found are easily forgotten. This condition was the motive for the preparation of the summary article appearing in this issue. It represents an attempt to give the reader the necessary data for forming his own opinion on the merits of the present situation or any new developments that may be brought about.

Reclamation

REMARKABLE developments occurred during 1923 in the subject of reclamation. Their effect on the actual state of affairs has not been very decided, however; favorable and unfavorable developments interacted in such a way that the situation of the projects as well as of our national reclamation policy is in almost as anxious a state as a year ago. Early in the spring, after all the alarm and disorganization which had been brought about by Secretary Work's uprooting and vilifying of the engineering organization, a report was rendered by the fact-finding commission, the Board of Special Advisers on Reclamation. This report turned out to be a remarkable document. The board refuted the Secretary's aspersions on engineers, unobtrusively condemned the landholders who had raised false clamor to conceal their attempt at juggling public money into their pockets, and exposed in clear language the evils of the system which had come to exist as the result of political management of reclamation. The board's recommendations threw a few sops to the malcontents, but in general were highly constructive. They brought into plain view the dangers inherent in governmental financing of local improvements; the same thing incidentally was done in the monograph issued later in the year by the Department of Agriculture, which proved by figures the huge financial subsidies that are going to a certain limited group of farmers through federal no-interest reclamation.

Subsequent to the Advisers' report, Dr. Elwood Mead, a member of the board, was placed in charge of the Reclamation Bureau. This hopeful event was in part counterbalanced, however, by the failure of Congress to enact a reform law recommended by the advisers which would have empowered Dr. Mead to make practical application of the board's findings, except that part of the reform bill was finally passed in December, as a rider on a deficiency bill. Thus, the badly needed revitalization of the reclamation projects could proceed but slowly and the engineering staff disintegrated further, F. E. Weymouth, the chief engineer, resigning among others. There is hope ahead for reclamation affairs, but much hard work remains to be done before the hope can be realized.

In the other half of the reclamation problem, that relating to new projects, only a few beginnings of progress have been made; but these are of utmost significance. Dr. Mead made it a point to enter into thorough investigation of the economic advisability of new projects, and drew groups of local men into this investigation work. The results tended to show (though they have not generally been so interpreted) that further investment of national moneys in Western irrigation is certain to be an unconscionable waste, unless greatly improved efficiency is brought about by radically new methods, and incidentally the usurers and land profiteers are forced out of the deal. It is proposed to do this by land control, by financing the settlers, and by aiding in all the starting-up difficulties. Bills to authorize such procedure are now in Congress.

Professional Matters

PROFESSIONALLY there is little to record for the recent year. As noted in the short article in this issue this was a non-legislative year so there was no action as to engineers' licensing. Nothing constructive has been added to the thinking for or against registration or licensing. It is in effect to a greater or less degree in nearly half the states, but so far there is no indication that it is either desirable or dangerous. Those who favor licensing have always claimed that its benefits would be slow to be appreciated, inasmuch as they would show only in a raised professional morale and standards. The opponents, on the other hand, have said that licensing was passively not actively evil, in that it would not accomplish any of its desired ends and would merely add complications to professional life. The burden of proof continues to remain with the advocates.

Professional societies have marked time. American Engineering Council still exists—though singularly silent. How much longer its devotees are to be allowed in the arduous task of justifying its existence remains a question. The American Society of Civil Engineers, sorely hampered in mid-year by the loss of its efficient secretary, is finding difficulty in working out the most effective operation of the newly formed technical divisions. The American Association of Engineers, recovering slowly from its low point in membership, is working hard in matters of professional relief, though it has not yet altogether found itself or made its objectives entirely clear to the rest of the profession.

The S.P.E.E. investigation of engineering education has begun to function actively, through the medium of the faculty committees at each institution, but results are still a year or so ahead. Meanwhile, as the statistics on another page show, the technical schools continue just about to hold their own as to numbers. This is not a matter of regret, as some seem to think, but rather of congratulation, so long as the funds available for engineering education remain static. Our schools cannot efficiently turn out more engineers, and while the leaven of more engineering education would doubtless help raise the general tone of college graduates, the needed specialist product is being supplied satisfactorily at present and should not be diluted by adding more who cannot be taken care of.

The Colorado River—

A Brief Summary of Data

Since the formulation of the Seven States Compact on Colorado River utilization in 1922, no progress has been made toward the solution of the issue which the river presents. Power, irrigation and protection from flood disaster are involved on a huge scale, but intense antagonisms of interest and divergences of view block progress. Arizona has refused to ratify the compact, which failed to adjust conflicting state claims to water and power. A sharp battle has waged around the Boulder Canyon reservoir proposal for several years. The Swing-Johnson bill of the last session of Congress and the recently introduced Fredericks bill would recognize the vast scope of the problem by making it one for national solution. National participation is dictated also by the fact that our relations with Mexico are involved. The problem is rapidly becoming critical. The present article brings together the physical data of the problem in highly condensed form, as a basis for engineering opinion.—EDITOR.

SINCE the time of the dramatic fight to save the Imperial Valley from inundation, after the Colorado River broke through its levees in 1905 and poured into the valley, the river has been under continuous discussion. It presents the most important question of the West. Within the last few years it has been made prominent by a series of events, especially the introduction of the Swing-Johnson Bill and the drafting of the Colorado River Compact by the seven states of the basin.

FIG. 1—RELATION OF COLORADO BASIN TO UNITED STATES

In the discussions the facts at the bottom of the problem have tended to become obscured. The following abstract of the essential data of the Colorado has therefore been assembled to assist the reader in his own study of the complex issues and controversies. The data are presented in much condensed form with a view to their ready understanding. The extraordinary character of the problem is illustrated by the dam sketched in Fig. 8 and the fantastic Arizona High Line irrigation scheme outlined in Fig. 10, by the remarkable conditions surrounding the Colorado River Compact, and by the unparalleled situation of the Imperial Valley.

Colorado Basin and River

Description—The Colorado River Basin, embracing parts of seven states, covers one-thirteenth of the United States (Figs. 1 and 2) and has an area of 244,000 sq.mi. Elevations range from 14,000 ft. to sea level. The river flows many hundreds of miles through deep canyons. The basin contains 500,000 people, has a great mining industry, and 4,000 sq. mi. of irrigated farm area, but little or no manufacturing. It produces $150,000,000 worth of minerals annually (estimate of G. J. Young, of *Engineering and Mining Journal-Press*). It has enough fertile land to permit doubling or tripling its irrigated area. It is rich in copper and its resources in non-metallic minerals are very great. Its undeveloped power resources are the greatest in the United States.

All of the basin is arid or semi-arid, and requires irrigation to grow crops. However, as the river is generally far below the level of the country, except for narrow bottoms and a few intermountain valleys, the lands desiring to use its waters for irrigation must depend on long, costly canals or extremely high impounding works, or both.

The river is about 1,700 miles long from the headwaters of the Green River to the Gulf of California. In flood time its volume is as large as that of the Ohio River in flood or as the full flow of Niagara Falls. It has a very steep profile. Fig. 3 embodies the data of the U. S. Geological Survey, including those supplied by the 1923 expedition. In the principal canyon section, for nearly 300 miles the average fall exceeds 7½ ft. per mile (mouth of Little Colorado, El. 2,715; mouth of Virgin River, El. 740; fall, 1,975 ft.; distance by river, 262 miles); while much of this fall is concentrated at rapids, even the stretches of smooth water between have an average fall of 3 ft. per mile. In the delta the fall is about 1 ft. per mile.

Water Data

Source of Water—Most of the river flow (roughly 90 per cent) originates in the upper region; only 10 per cent is contributed by that part of the basin lying below the Utah-Arizona line (see flow diagram, Fig. 5).

Volume of Flow—The mean annual discharge of the river below the mouth of the Gila, without depletion by diversions out of the watershed or use for irrigation, may be taken at 18,000,000 to 20,000,000 acre-ft. per year (the actual figures are in dispute). Irrigation and diversion consume over 5,000,000 acre-ft. (Gila basin included), so that the annual surplus discharged into the Gulf under present conditions is probably about 13,000,000 to 14,000,000 acre-ft.

Variation of Flow—Within the period of record the yearly discharge of the Colorado at Yuma has varied from a low figure of about 8,000,000 to a high figure of about 27,000,000 acre-ft. Variations of flow within the year (Fig. 4) are even greater in range, from minima of 2,000 sec.-ft. below Yuma to maxima exceeding 200,000 sec.-ft.

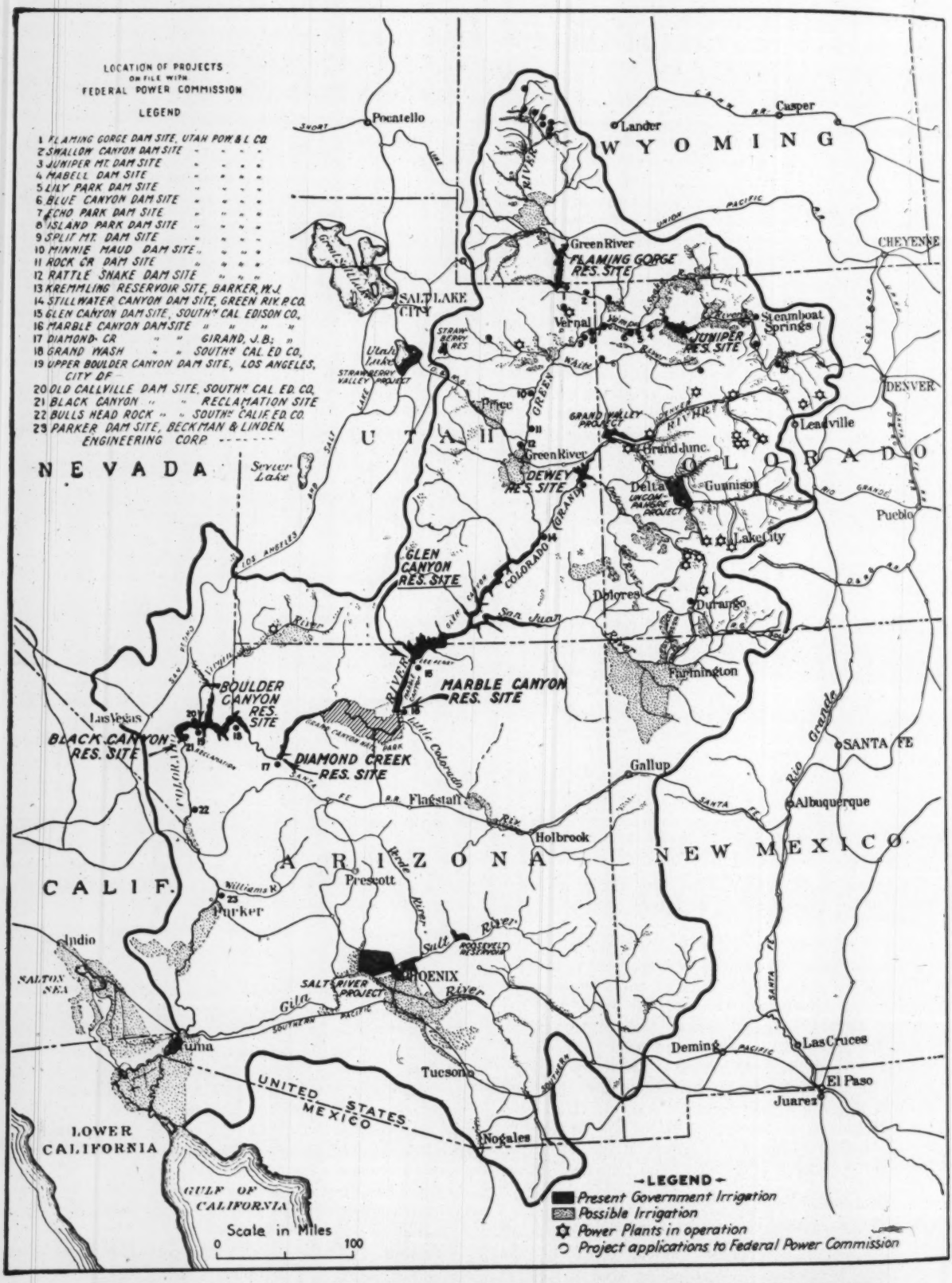


FIG. 2—MAP OF COLORADO RIVER BASIN INDICATING POWER AND IRRIGATION POSSIBILITIES

The shaded areas indicate one estimate of ultimate irrigation possibilities. Power sites for which application has been made to the Federal Power Commission are shown by numbered dots, while stars denote existing powers.

The Silt Burden

Colorado River water is so high in suspended matter that the river is classed as one of the muddiest in the world. The total silt volume carried down is over 100,000 acre-ft. per year, of which one-fifth comes from the Gila. Most of it deposits in the delta region and continually builds up this area. This silt deposition was the original cause of the delta formation (Fig. 6), and subsequently led to the river discharging alternately into the Salton basin and the Gulf.

Irrigation Possibilities

North of Arizona, net irrigation use is about 1.5 acre-ft. per acre per year. The lower part of the basin requires 4½ to 5 ft. The upper region has a short season and low-value crops, the lower a long season (all-year irrigation) and relatively high-value crops.

Because of the difficult topography, the future irrigation projects will in general cost $100 to $200 per acre for the main irrigation works alone.

Present Condition—At present about 1,500,000 acres in the upper basin (north of Arizona) are irrigated and about 1,000,000 acres in the lower basin, including the Gila Valley. About 5,000,000 to 7,000,000 acre-ft. are being consumed per year, using up the entire low-water flow of the river.

Future Irrigation—Future irrigation possibilities have been investigated by the Reclamation Service and classified for likelihood of development in the immediate future, in the near future, and in the remote future.

The approximate figures are:

IRRIGATION DEMANDS, COLORADO AND GILA RIVERS

Water Consumption Acre-Ft. Per Year, (Figures in parentheses acres irrigated)

Location		Present	Total Immediate Future	Total Near Future	Total, Ultimate
Upper Basin...	A.....	(1,450,000)	(2,200,000)	(3,200,000)	(4,200,000)
	Acre-ft.	2,000,000	3,400,000	5,100,000	6,500,000
Lower Basin, U. S.....	A.....	(1,000,000)	(1,600,000)	(1,650,000)	(2,500,000)
	Acre-ft.	4,000,000	6,000,000	6,000,000	7,500,000
Lower Basin, Mex.....	A.....	(190,000)	(490,000)	(800,000)	(800,000)
	Acre-ft.	600,000	1,500,000	2,500,000	2,500,000
Total.....	A.....	(2,600,000)	(4,300,000)	5,500,000)	(7,500,000)
	Acre-ft.	6,600,000	11,000,000	13,500,000	16,500,000

Some of the more extreme projects are not included. Prevailing belief is that the river flow properly administered is ample to supply all prospective agriculture within its reach although calculations by the Geological Survey suggest that the flow of the river is at least 1,000,000 acre-ft. per year short of meeting the full "ultimate" demand.

Salt Content—The Colorado carries 200 to 300 parts of salt per million during floods—about the same as the Rio Grande—but 1,200 parts or more during the eight non-flood months. This approaches the danger point for permanent success in irrigation. The salt content ("alkali") may have a limiting effect on future irrigation.

Other Demands for Water—In addition to the irrigation demands, some diversion of water, to a total of possibly 500,000 acre-ft. per year, is included chiefly in eastern Colorado mountain region. Some of this water is for Denver municipal purposes. Claims upon Colorado River water for municipal purposes have also been advanced by Los Angeles and San Diego.

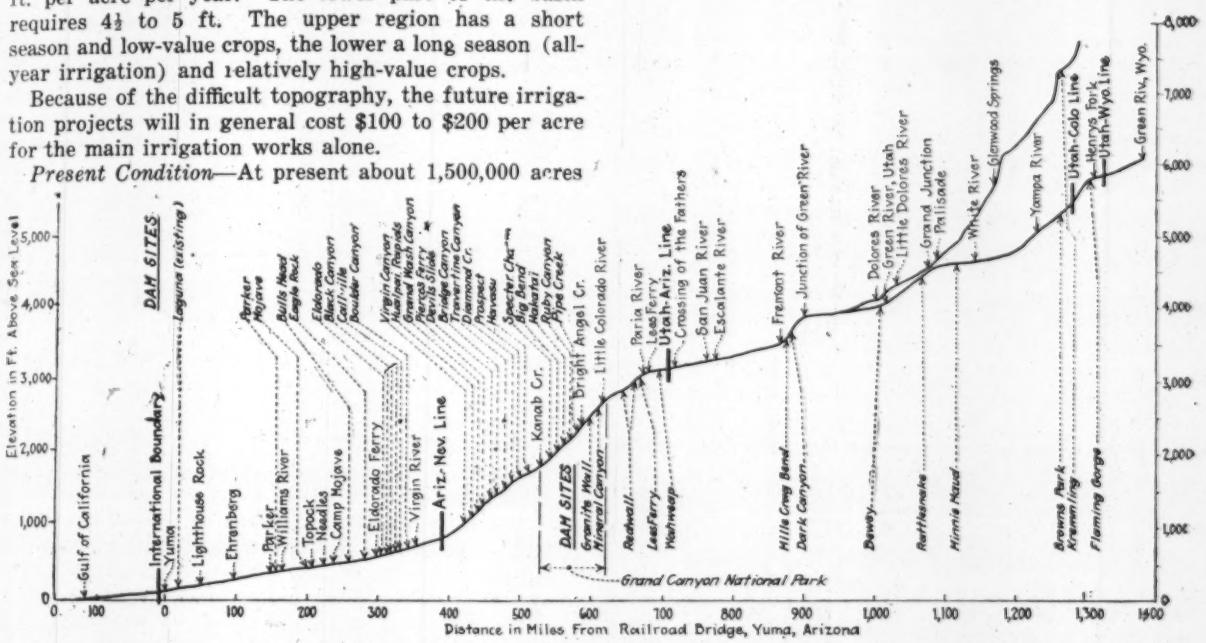


FIG. 3—PROFILE OF COLORADO FROM HEADWATERS TO THE GULF OF CALIFORNIA

The dam sites located by the Geological Survey expedition of 1923 are indicated, as well as a few of the sites on the upper river.

Power Possibilities

There is enough potential hydro-electric power in the Colorado to supply over half of the present central station output of the United States.

Dam sites adaptable to large-size developments occur all along the course of the main river and most tributaries. The present flow would produce probably well above 7,000,000 continuous hp. The ultimate total may be between 3,000,000 and 5,000,000 hp.

The most promising market for the near future is California industrial and general use, irrigation pumping and railroad electrification. The market is limited, while high construction cost will require developments to be made in large blocks of power (minimum several hundred thousand horsepower). A development of 300,000 to 500,000 hp. is immediately feasible.

Various corporations and individuals have applied to the Federal Power Commission for licenses to develop power on the Colorado (Fig. 2). Los Angeles has also applied. No action has been taken on any application, however, the commission having decided to delay action until other questions of the river are adjusted.

Physically and hydraulically there is no necessary conflict between the various applications and possible developments on the river. They do conflict as to market, however. It is generally conceded that the first license granted by the Power Commission will, by absorbing the market demands, tend to block other developments. Many well-informed people recognize the possibility that in future power will become more important than irrigation in the Colorado basin.

Flood Dangers and Flood Control

Each summer's high water threatens the bottom lands of the lower reach of the river from Needles to Yuma and the Imperial canal. The river flows in a bed built up above the surrounding country by past flood deposits, and overflows its natural banks at a moderate stage. Occupied bottom lands are protected against the higher flood stages by levees. Levee construction at Yuma costs about $100,000 each year, $2 per acre of land protected.

By all odds the greatest menace is in the delta region south of Imperial Valley. The story of conditions and events in this region is too long for review here, but attention is called to the fact that the river, which built the delta (compare Figs. 6 and 7), flows practically on the crest of the flat rise between the Gulf and the Imperial Valley, 30 to 50 ft. above sea level. It naturally tends to overflow, by preference down the steeper northward slope to the Imperial Valley, whose deepest point is 270 ft. below sea level, and from time to time tends to take a new and shorter route either toward the Gulf or toward the Imperial Basin. This

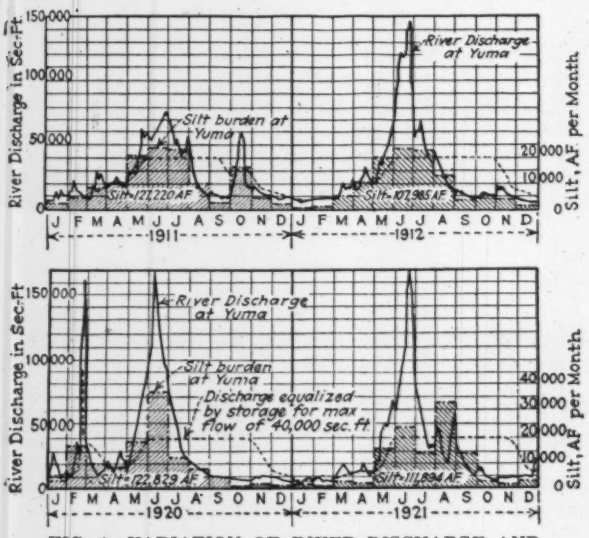

River Discharge in Sec.-Ft.
River Discharge at Yuma
Silt burden at Yuma
Silt, AF per Month
Silt-127,220 AF
Silt-107,985 AF
J F M A M J J A S O N D J F M A M J J A S O N D
1911
1912
Discharge equalized by storage for max flow of 40,000 sec.ft
Silt-122,829 AF
Silt-111,894 AF
1920
1921

FIG. 4—VARIATION OF RIVER DISCHARGE AND SILT DISCHARGE

Measurements made at the Yuma gaging station. Spring and autumn floods come from the Gila, the regular summer flood from the upper Colorado.

natural condition prevailed until after 1902, when the Imperial irrigation system was begun. Now and in future, therefore, the shiftings and outbreakings of the river must be prevented and its course stabilized on ground much higher than the adjoining lands.

Prior to 1905 the river flowed in a fairly direct course from Yuma to the Gulf. In 1905 it broke out to the West a few miles below the international boundary, and flowed down the Alamo River into the Imperial Valley

FIG. 5—FLOW MAP OF THE COLORADO

After E. C. LaRue. The width of the shaded area is proportioned to mean annual flow.

for nearly two years, flooding its lowest portion and forming a lake of hundreds of square miles, which still exists and is used as sump for the irrigation overflow waters. In 1907 it was turned back into its old course by strenuous work of the Southern Pacific Co., but two years later it broke out westward some distance downstream and assumed the course of the Bee River, one of the blind delta drainage channels, to Volcano Lake, a large marshy area at the westerly end of the delta crest. Along this course the river was guarded by a series of levees. Thereupon it built up its bed, particularly at Volcano Lake, so that in 12 years it raised the maximum flood elevation near the lake by about 13 ft., and in spite of repeated raising of the levees threatened destruction of the protective system in 1921. Immediately thereafter the Imperial Irrigation District set about diverting the Bee River southward through a new cut channel to an area 10 or 20 ft. lower in elevation, in the upper courses of the Pescadero, another delta drainage stream. It is now depositing its silt in the Pescadero region, but is rapidly approaching a new danger period.

As flood actions in this region involve both water and silt, effective flood control requires both reduction in flood volume and elimination of silt. As to the former, the reclamation engineers who have been concerned with river fighting at Yuma believe that the maximum flow must be reduced to 40,000 sec.-ft. Col. William Kelly, chief engineer of the Federal Power Commission, has concluded that reduction of maximum flow to 80,000 sec.-ft. would be adequate for the present. The reclamation engineers estimate that reduction of floods to 40,000 sec.-ft. requires 8,000,000 to 10,000,000 acre-ft. of available reservoir capacity, while Col. Kelly considers that 4,000,000 acre-ft. storage would be sufficient.

Silt elimination is essential because continued silt deposition in the delta, even with reduction of flood peak, will continue the process of upbuilding and outlet blocking of the river which is the cause of the unstable river conditions. The Reclamation Bureau plans for a large flood control and flow equalization reservoirs provide separate capacity for silt retention. A capacity of 5,000,000 acre-ft. (AF) silt storage space is considered necessary. In the future, progressive equalization of the stream will probably reduce the silt burden by reducing flood erosion.

Relations with Mexico

The supply canal of the Imperial Valley carries irrigation water through Mexico under a contract made about twenty-five years ago between two corporations, owners

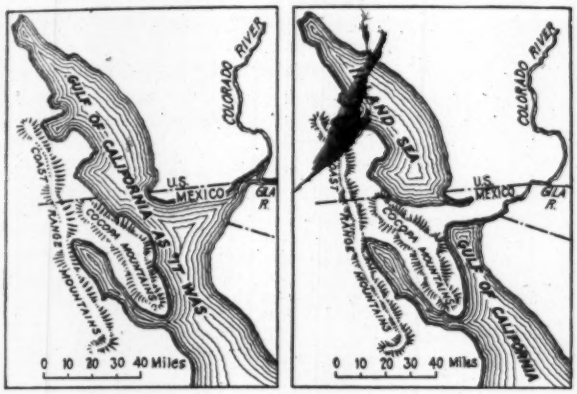


FIG. 6—PREHISTORIC DELTA CONDITIONS
Original condition and a later stage, as sketched by J. H. Gordon, U. S. Weather Bureau, Yuma.

of land on the American and the Mexican side of the boundary respectively, and a Mexican government concession which in substance provide for the carriage of a flow of 10,000 sec.-ft., but require that half the flow shall, upon demand, be sold to Mexican lands. Water carriage through Mexico and the protective work there are carried on by a Mexican corporation, itself owned by the Imperial Irrigation District. Customs duties and other matters of official control create many difficulties in this work. The use of half the water by Mexican lands in low-water period causes serious water shortages in the Imperial Valley, where the irrigated area (nearly 500,000 acres) is much larger than south of the line (190,000 acres). Rather free extension of irrigated areas in Mexico is therefore possible, while on the American side such extension is hazardous on account of water shortage. Separate from differences of view as to irrigation demands, however, a most serious condition lies in the fact that the flood danger and the protective works are in Mexico.

No treaty between Mexico and the United States exists as to this condition.

State Relations and the Compact

Reservoir storage of flood water would permit additional irrigation in the lower basin, but would thus, by right of prior appropriation, tend to limit the future development of the upper basin. For this reason the upper states were opposed to the creation of any main storage on the stream until they could, by interstate agreement, establish a right to a share of the river flow which would not be affected by beneficial appropriation. Apprehensions of this kind led to the formulation of the famous Colorado River compact, or Seven States Compact, two years ago.

This compact apportions "in perpetuity" to the upper basin (region above Lees Ferry) 7,500,000 AF per year and to the lower basin 8,500,000 AF, with provision for apportioning any surplus after 40 years and for supplying from the allotment of both basins in equal shares any water that may be assigned to Mexico. It declares that power use of water shall be subservient to agricultural and domestic use.

One of the commissioners who drafted the compact has stated that at the beginning of the movement "the thought was that there could be an apportionment of the waters of this river among the states individually, giving so much water to Colorado, so much to California, so much to Utah, etc. No agreement could be reached along that line." Because of this failure and

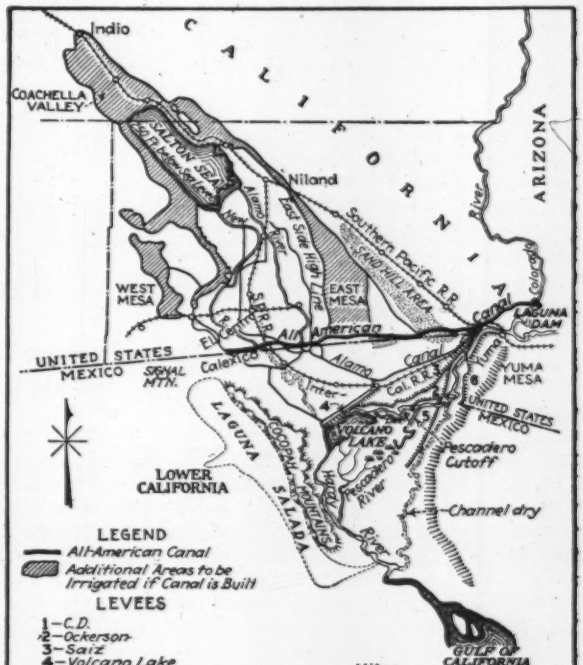


FIG. 7—IMPERIAL VALLEY AND DELTA CONDITIONS
The possible extension of irrigation along the borders of the Imperial Valley by supply at higher level than that of the present canal is indicated by shading. Some features of the disturbed conditions in the delta are indicated.

the fear that California would appropriate the full 10,000 sec.-ft. share of the lower basin, of which it already has more than half, Arizona has refused to ratify the compact, while the legislatures of the six other states have ratified it, as required to make it effective. The compact raises other questions besides those of state apportionment, and affects the whole status of water rights, including the question of federal jurisdiction over unappropriated river flow. It provides no machinery for administration or enforcement. It requires the upper basin to deliver not 7,500,000 AF per year, but 75,000,000 AF in any ten-year period, so that the lower basin might have a shortage in supply during some years.

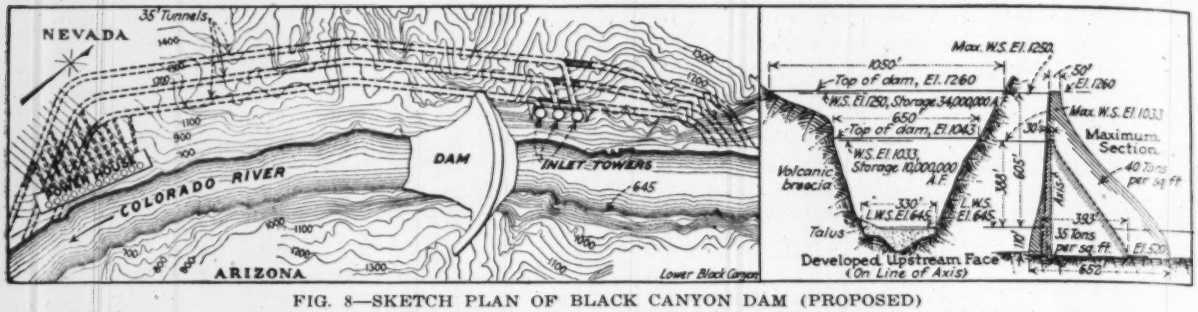


FIG. 8—SKETCH PLAN OF BLACK CANYON DAM (PROPOSED)

The Black Canyon plan, with its huge diversion tunnels, illustrates in typical manner the magnitude of the problem of damming the Colorado at any of the important reservoir locations.

All-American Canal

To simplify international questions the construction of a canal from Laguna Dam to the Imperial Valley passing wholly through American territory was proposed seven or eight years ago. In 1919 such a canal was surveyed by a board of engineers at the direction of Congress; its cost was estimated at $30,000,000. The route (see Fig. 7) passes for a number of miles through a region of drifting sand hills, and construction and maintenance of the canal here promise to be exceedingly difficult. The canal would assure a supply to the Imperial Valley and adjacent irrigable regions without diversion of several thousand second-feet to Mexico, but it would not remove the delta flood menace. There has been some discussion of other possibilities of supplying the valley through American territory, possibly with pumping to cross the divide.

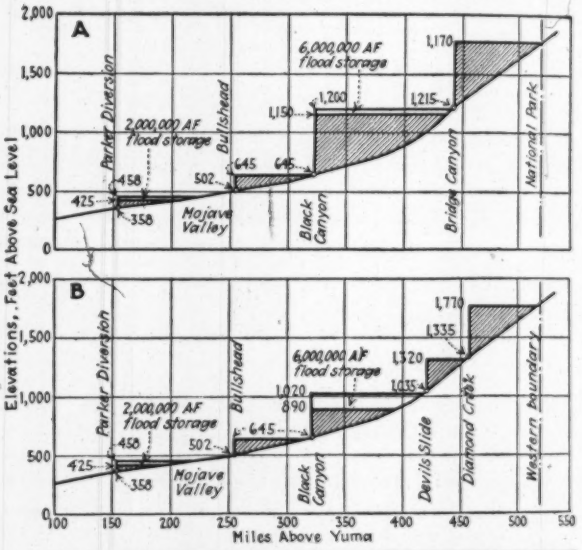
Efforts to Solve The Colorado Problem

An active part has been played by the federal government in connection with the Colorado problem for many years. The U. S. Geological Survey has studied the hydrological phenomena of the river for many years. The first full hydrological study of the Colorado basin was prepared in 1916 by E. C. La Rue, of the Survey, and published as Water Supply Paper 395. The Reclamation Service has been intimately concerned with the river since its organization.

For five years Congress has had under consideration bills for federal construction of the All-American Canal and of a storage reservoir on the Colorado (Kettner bill and Swing-Johnson bill). In 1920 and 1922 Congress directed investigation of the Colorado by the Reclamation Service. This work resulted in a full report by A. P. Davis, published in 1922 as Senate Document 142, and in a later report by F. E. Weymouth in 1924, as yet unpublished.

In the course of its studies of the river, the Reclamation Service some years ago developed a project for dealing with all the major questions of the lower river by the construction of a huge equalizing reservoir near the foot of the canyon section, where conditions are favorable for building a dam 550 to 600 ft. high, producing a storage capacity of 25 to 34 million acre-feet, corresponding to the amount found to be necessary for the purpose. The dam was originally located in Boulder Canyon, a short distance below the mouth of the Virgin River, but in the later studies was shifted to Black Canyon, 20 to 30 miles below, where several favorable sites exist. The equalized outflow would develop 500,000 to 650,000 continuous horsepower. This project has stirred up much opposition, yet it is today the only concrete proposal for solving the physical problems of the Colorado. A bill now before Congress, the Swing-Johnson bill, proposes to carry it out and appropriates $70,000,000 for constructing the dam and an all-American canal (not necessarily the canal described above). A Senate committee is holding hearings on the bill at present, while hearings before the House committee, held last spring, have been published.

Most recent of such proposals is the Fredericks bill,



Plan	Conditions With Present Day Water Supply: Total Head Utilized	Total Power Available	Total Cost	Cost Per Installed Hp.	Conditions With Full Upstream Development and Complete Upstream Storage Control: Total Power Available	Total Cost	Cost Per Installed Hp.	Evaporation Loss Aver.	Total Storage Capac. for Silt, Floods & Equating Stream Flow
	Feet	Hp.	$1,000,000	Dollars	Hp.	$1,000,000	Dollars	Sec. Ft.	1,000,000 A.F.
A	1,353	3,090,000	339	110	2,810,000	316	111	1,400	32.7
B	1,338	2,350,000	303	128	2,825,000	331	116	940	14.9

FIG. 9—TWO OF VARIOUS STORAGE PLANS ANALYZED IN WEYMOUTH REPORT, 1924

Plan A is recommended as giving most advantageous development for river control and irrigation equalization and power production in lower river of all the plans considered.

introduced last month, which would have the government build a dam at or near Boulder Canyon for flood control and flow equalization only, this dam to be also a substructure for power development construction. The superstructure and power rights are to be dealt with under the Water Power Act. The bill attempts to reduce the immediate problem to its lowest terms.

To bring about harmonized engineering opinion within the circle of the several government bodies concerned with the Colorado, the Secretary of the Interior last

year formed a board including representation from the Geological Survey, the War Department, the Federal Power Commission, and the Bureau of Reclamation. This board was to report on the needs of the river and recommend how they might be met, but it failed to agree in the main. The representatives of the Bureau of Reclamation reported in favor of a large single-storage project combining flood control, silt elimination, irrigation equalization, and power (the Weymouth report of 1924 constituted their report). Colonel Kelly, for the Power Commission, and Herman Stabler, for the Geological Survey, presented separate reports, Colonel Kelly condemning the Boulder Canyon reservoir and proposing a small reservoir at a new site, near Needles, for flood control but not for equalization of flow. One of the points of disagreement was whether the cost of a dam serving other uses than power should be paid for wholly from power income.

General Summary

To summarize the data given in the preceding:

1. The mean annual discharge of the Colorado is 18,000,000 to 20,000,000 AF gross, corresponding to a runoff of slightly less than 1½ in. from the drainage area (244,000 sq.mi.). The variation of flow is very great (3,000 to 200,000 sec.-ft.). The low-water flow has been appropriated, and in the lower reaches there is a shortage of water in the dry period. Present annual consumption leaves a surplus of 13 to 14 million acre-feet per year, of which 10 to 12 million acre-feet can probably be made available for utilization after deducting increase in evaporation and losses due to imperfect equalization. There is more than enough irrigable land to use all this water, but most of it will for a great many years be too expensive to develop.

2. Silt exceeding 100,000 AF per year is carried to the delta, most of it originating above the foot of the canyon region. Elimination of silt by detention and storage in a reservoir is necessary to remove the flood danger in the delta region.

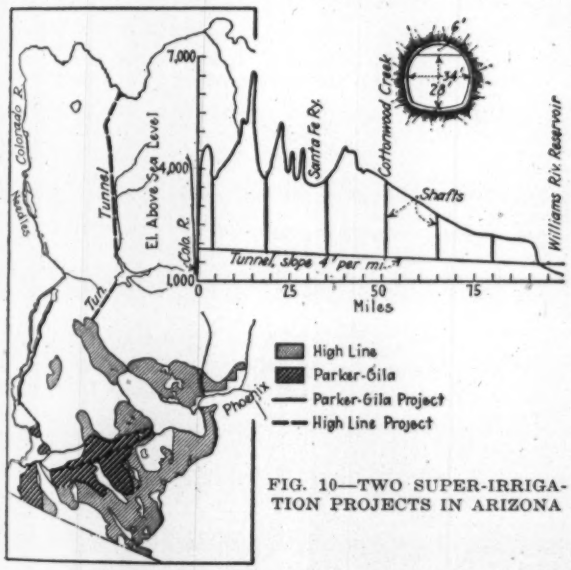


FIG. 10—TWO SUPER-IRRIGATION PROJECTS IN ARIZONA

3. Floods are dangerous and cause large losses each year. The condition of the delta is critical, as the instability of the river is increasing rapidly. Flood and silt detention is the only promising relief measure that has yet been proposed.

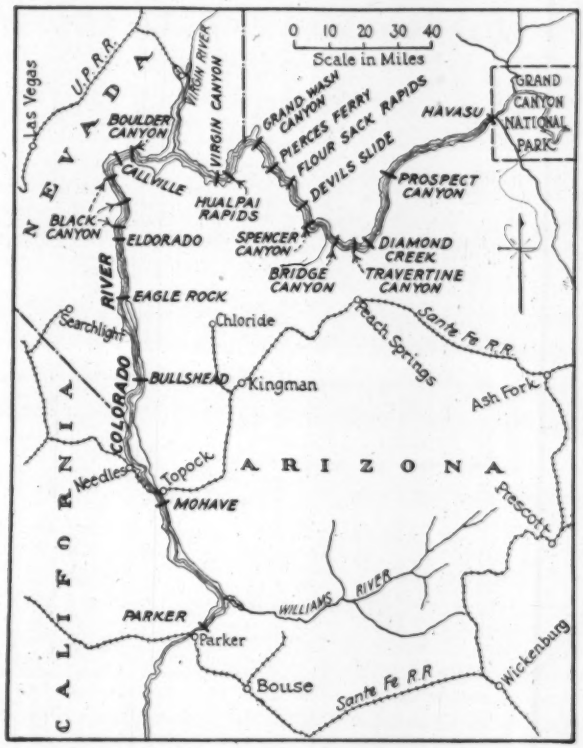


FIG. 11—DAM SITES BELOW GRAND CANYON
A number of these sites have recently been under discussion.

4. Flood protection requires reduction of maximum flow at Yuma to 40,000 to 80,000 sec.-ft., the smaller figure being best supported. Reserve storage capacity of five to ten million acre-feet below all important tributaries will control the main river to this degree. Gila River floods require separate control, but they are much less dangerous than the floods from the upper river.

5. For full utilization of the flow of the river very large storage (15,000,000 to 25,000,000 AF) is required to equalize the flow during the year and to provide holdover storage.

6. Power to an amount far exceeding present prospects for profitable utilization can be developed along the river. The ultimate total, with full use of water for irrigation, will reach several million horsepower. At present the power is of limited value, because of great first cost, limited market and long transmission distance. As soon as storage to equalize flow for irrigation is provided, the large heads necessarily obtained in canyon storage will make a considerable amount of continuous power available in the reservoir discharge.

7. Water shortage along the lower river and in the Imperial Valley warrants early provision of equalization storage, which can be added to a flood reservoir.

8. Complex international conditions affect the delta region. They can be disposed of only by a Colorado River treaty between the United States and Mexico. Without such a treaty neither flood dangers nor water utilization can be adjusted finally.

Other matters included in the present review may be summarized by the statement that there is great divergence of present views on every phase of the subject, and that the resulting controversies have operated to cause the critical nature of the case to be commonly overlooked.

Progress in Engineers Licensing

Review of the status of registration laws in the several states

By C. E. Drayer
Secretary, American Association of Engineers, Chicago

THE PAST year has added to the experience of operation under the engineers registration laws, but has not otherwise been significant. The year 1924 was an off-year for legislatures and consequently no additional states could be added to those already having laws, nor amendments offered to existing laws. The following states and territories have some form of registration or licensing law in force:

Alabama	Michigan	South Dakota
Arizona	Minnesota	Tennessee
Colorado	New Jersey	Texas
Florida	New Mexico	Virginia
Idaho	New York	West Virginia
Illinois	North Carolina	Wyoming
Indiana	Oregon	District of Columbia
Iowa	Pennsylvania	Hawaii
Louisiana	South Carolina	

Bills are in preparation for introduction in the 1925 legislatures in Arkansas, California, Missouri, Washington, Wisconsin and Utah. It is also reported that amendments of a decided character will be offered to the Wyoming law.

The period of adjustment to registration laws has been passing without friction of consequence, and the added year of operation strengthens the opinion that registration has come to stay. As usual in a movement of this sort, the first rush is followed by a slower period, but the addition of three of the five states having bills introduced in 1925 would make substantially half of the states have all-inclusive laws regulating the practice of engineering.

In Pennsylvania the suit to test the validity of the law is pending and neither side seems anxious to push it to a conclusion. More opposition developed in Pennsylvania than in any other state and it was due largely to deficiencies, particularly slowness in administration. In New York, something like 8,000 engineers have applied for registration of whom less than one-half, it is said, are on the membership rolls in organized engineering, which would indicate the unsoundness of the position of those who hold that membership in a recognized society is sufficient indication of proof of ability to practice engineering.

In some states there is a feeling that somebody ought to enforce the registration law, and in others there is the feeling that the law is weak but it is all that could be passed and amendments giving it teeth are in order.

In one or two states there is the beginning of an examination of the expenses of administering the law to see if fees cannot be reduced. In some states engineers are beginning to look to the time when the effect of the "grandfather's clause" shall have worn off, and are thinking of ways to insure engineering a professional status comparable to that of medicine.

In general, the year has been one of satisfaction with registration, with a determination on the part of the states having such laws to keep on in the same direction until only professional engineers in the sense of the college graduate or the equivalent may be registered. Another indication of the increased prestige due to recognition by legislation is the lessening use of the word "license" or even "registration." One state seems to be agreed that "admission to the practice of engineering" is the proper term.

The Council of the State Board of Engineering Examiners met in Washington, November 10-11. Reciprocity and the free flow of engineering talent across state lines and the desire to establish high standards mutually agreeable to the states have been sufficiently valuable to keep the council going, but it has not lent itself in any way to the extension into states not now having registration laws.

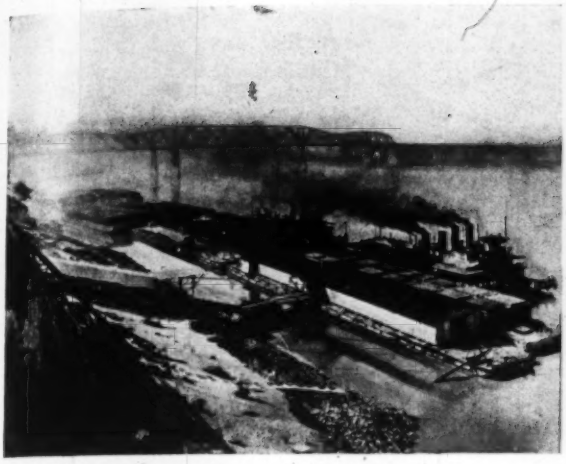
Enrollment in Engineering Schools Now Increasing

THE Bureau of Education has supplemented its usual biennial survey of education by a special study recently made of the enrollments in the engineering colleges of the United States. There are 133 engineering schools which report to the Bureau of Education. The enrollments recorded in the accompanying tabulation cover 121 of these schools for the four school years from 1921 to the present year.

COMPARATIVE ENROLLMENTS IN 121 ENGINEERING SCHOOLS FROM 1921-22 TO 1924-25

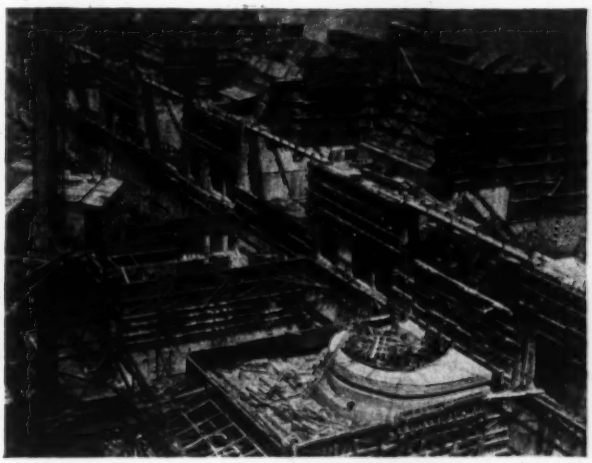
Based on enrollments for the first semesters of these college years. The total enrollment includes all curricula and courses of study.

Curriculum	Years	Freshman and Sophomore	Junior Year	Senior Year	Total Regular Fourth-Year Students
Total enrollment...	1921–22	35,739	11,870	9,157	56,766
	1922–23	31,470	10,823	9,995	52,288
	1923–24	32,129	11,108	9,189	52,426
	1924–25	33,721	10,523	8,589	52,833
Civil Engineering...	1921–22	8,065	2,695	2,078	12,838
	1922–23	6,761	2,433	2,018	11,212
	1923–24	6,819	2,555	1,907	11,281
	1924–25	8,738	2,681	2,271	13,690
Mechanical Engineering...	1921–22	9,105	3,005	2,343	14,453
	1922–23	7,774	2,637	2,481	12,892
	1923–24	6,675	2,480	2,229	11,384
	1924–25	6,072	2,181	1,831	10,084
Electrical Engineering...	1921–22	8,363	2,961	1,951	13,275
	1922–23	7,613	2,658	2,360	12,631
	1923–24	10,786	3,171	2,510	16,467
	1924–25	11,347	3,030	2,279	16,656
Chemical Engineering...	1921–22	4,444	1,406	1,204	7,054
	1922–23	3,207	1,082	1,097	5,386
	1923–24	2,738	1,067	929	4,734
	1924–25	2,478	884	746	4,108
Mining and Metallurgical Engineering...	1921–22	1,824	481	590	2,895
	1922–23	1,545	514	602	2,661
	1923–24	978	447	473	1,898
	1924–25	898	333	332	1,563
All other curricula and courses of study.....	1921–22	3,938	1,332	991	6,251
	1922–23	4,570	1,499	1,437	7,506
	1923–24	4,133	1,388	1,141	6,662
	1924–25	4,188	1,414	1,130	6,732



Memphis River Terminal

Municipal terminal at Memphis, Tenn. Scene at Georgia Ave. terminal. Two tows switching out Memphis loads.



Wilson Dam, Florence, Ala.

A construction photograph of Muscle Shoals project.

Progress in CONSTRUCTION WORK During 1924

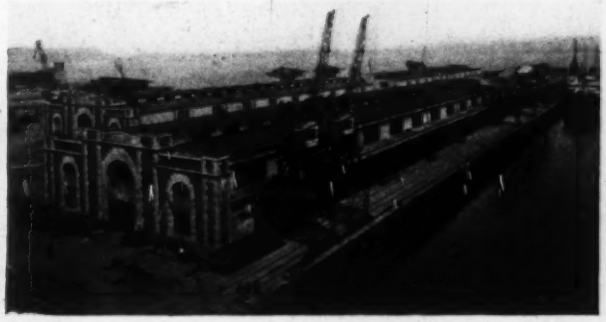
Eight pages of views of outstanding North American projects scattered from Coast to Coast

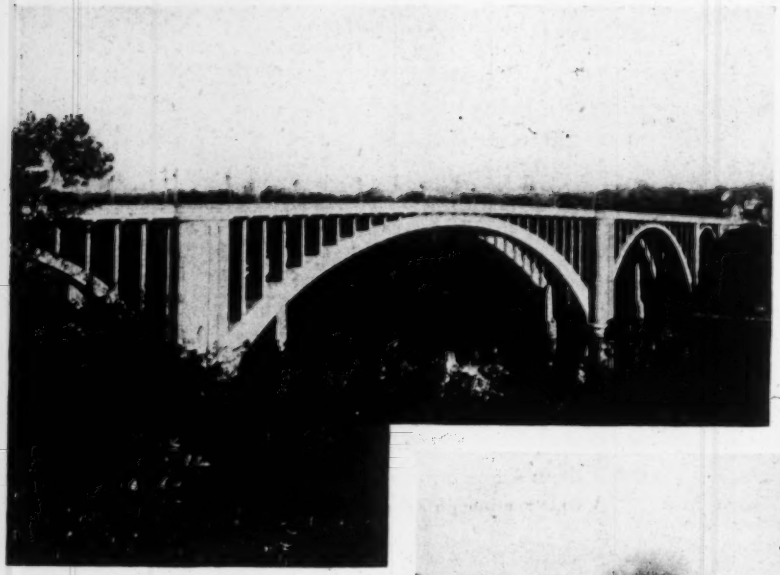
Pasadena Sewage-Disposal Plant

Activated sludge plant usually referred to as "Tri-Cities" sewage-disposal plant.

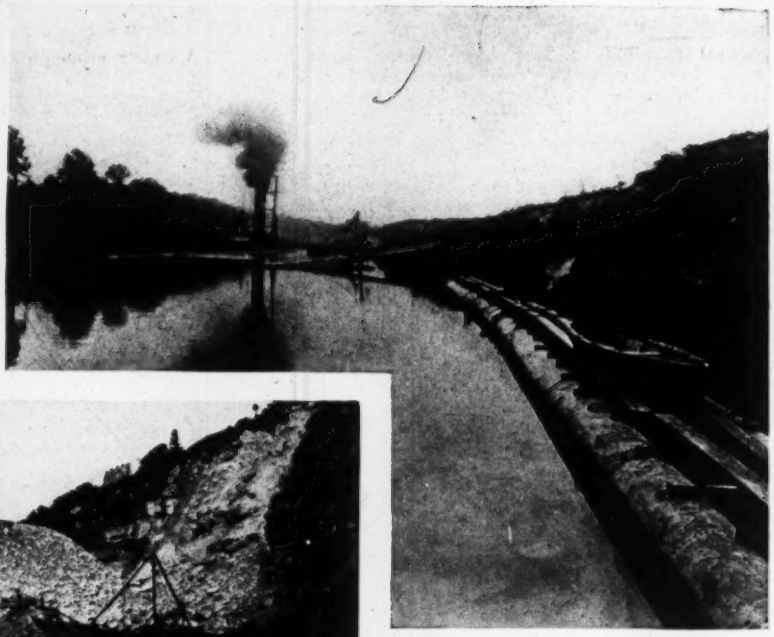
Ballantyne Pier, Vancouver, B. C.

The government-owned pier, recently completed.

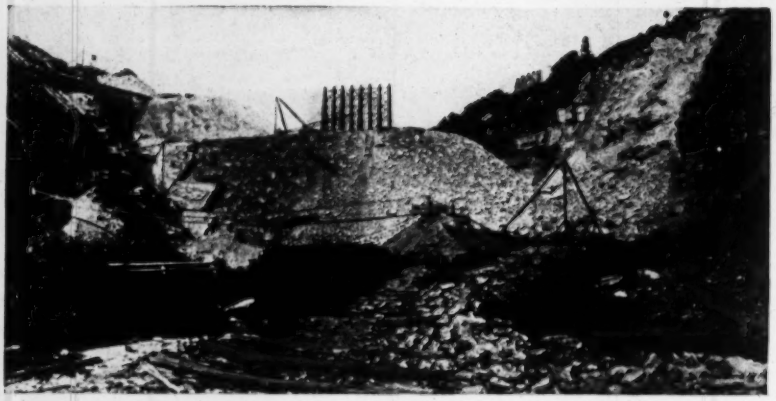




Cappelen Memorial Bridge, Minneapolis



Dix River Dam, Kentucky
Highest Rock-Fill Dam in the World.

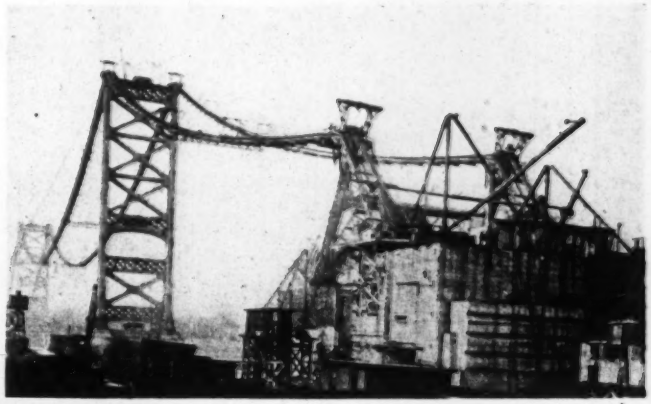


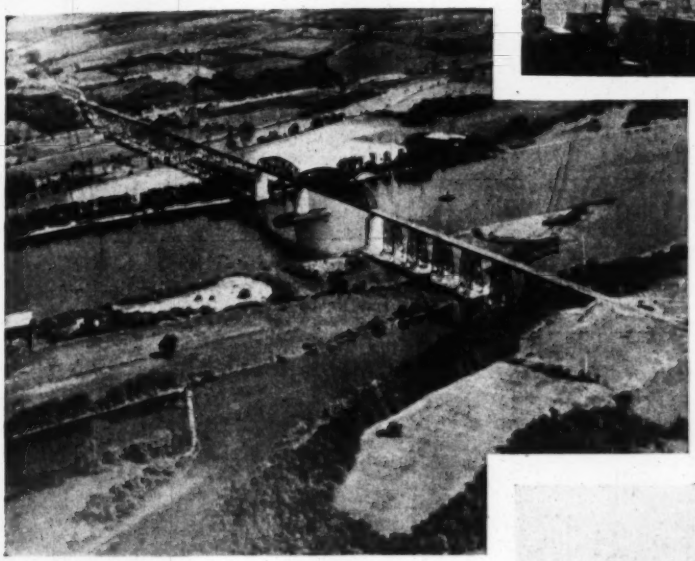
Chesapeake and Delaware Canal
One of the largest excavation jobs being carried on by Corps of Engineers.

Los Angeles Sewage-Disposal Plant

Philadelphia-Camden Suspension Bridge

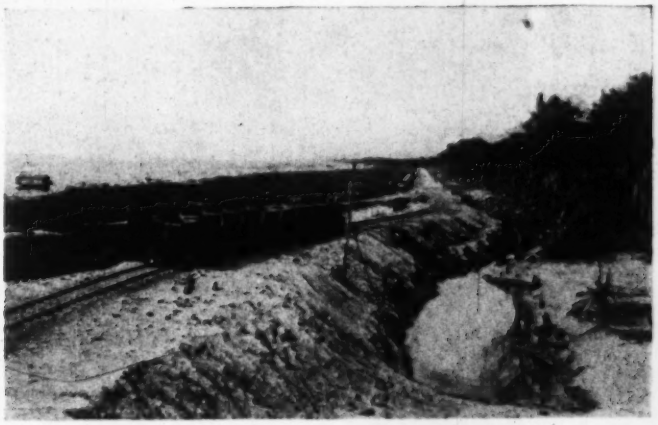
Footbridges and cables, looking northwest from Baird's Pier, Camden. Status of work in early December, 1924.





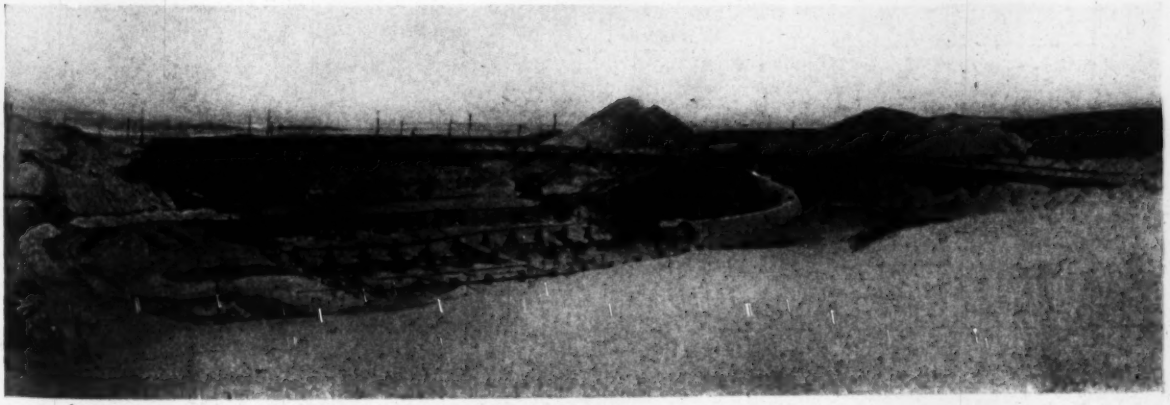
Smith Memorial Bridge, Castleton, N. Y.

Recently dedicated structure of the New York Central Lines across the Hudson River.



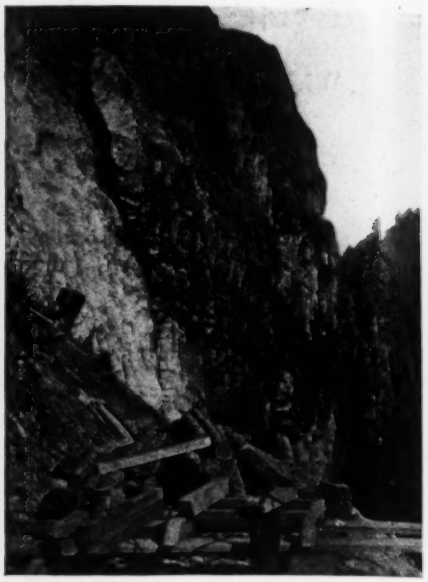
The Conners Toll Road in Florida

This highway which traverses the Everglades was recently opened to traffic.



Los Angeles Sewage-Disposal Plant

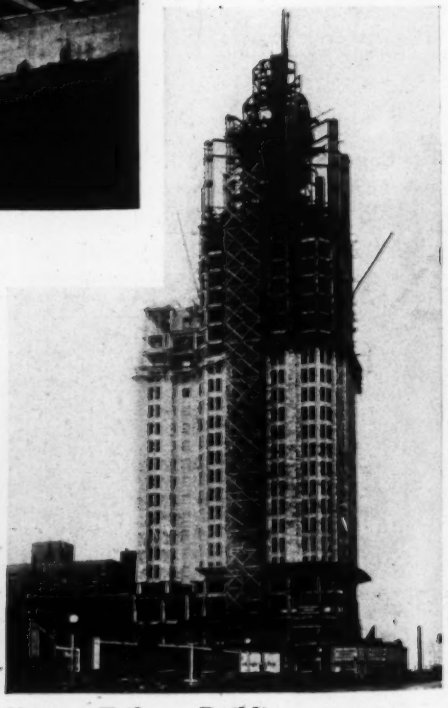
Double-Track Work in California
Southern Pacific's heavy grading across the Sierra Nevada Mountains.



Natron Cutoff in Oregon
North end of Tunnel No. 1 on the Southern Pacific's new line in Oregon.

Buffalo, N. Y., Filtration Plant

Stadium of the University of Minnesota

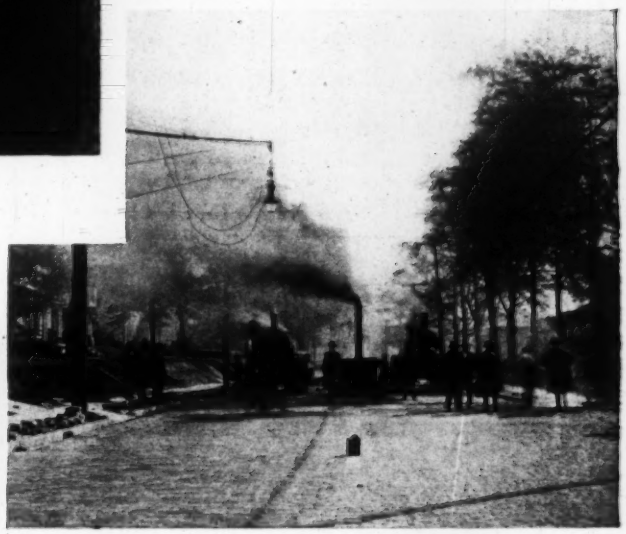


Chicago Tribune Building

Tracklaying in Kentucky: Illinois Central Ry.

Heavy Grading Work in Illinois: Chicago, Burlington & Quincy R.R.

Fort Snelling-Mendota Bridge, Minnesota



Brick Paving Work in Ohio
White brick were laid alternately with vitrified brick to make a permanent center line.

Pile Foundation for New Jersey Factory
Foundation work for the Western Electric's Kearny plant. Heavy concrete mats and pedestals were carried by 200,000 timber piles.

Pipe Line Across San Francisco Bay
One of thirty-six 107-ft. spans to carry Hetch Hetchy pipe line across the lower end of San Francisco Bay.

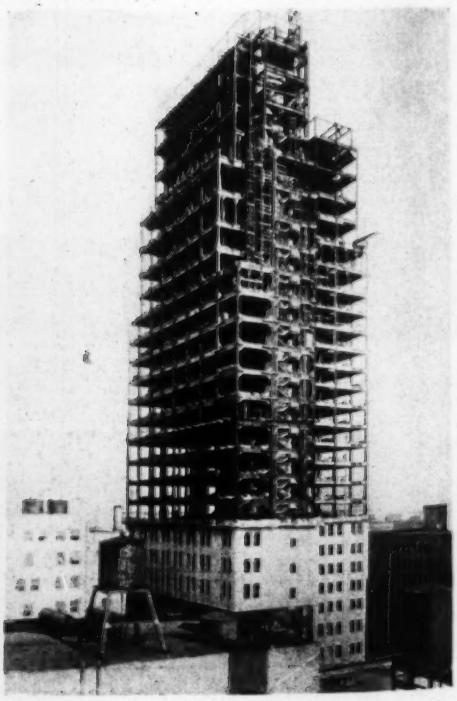
Troy-Cohoes Bridge over the Hudson
A project recently completed by the New York Department of Public Works.

Moffat Tunnel Through Colorado Rockies
Top heading of the six-mile railway bore being driven by the Moffat Tunnel Commission.

Foundation for Book Cadillac Hotel, Detroit
Excavation carried down 50 to 60 ft. Streets held up by curb walls and braced with inclined shoring.

Chicago Union Station

Pit Number 3 Project in California
One of the hydro plants under construction on the Pit River by the Pacific Gas & Electric Co.



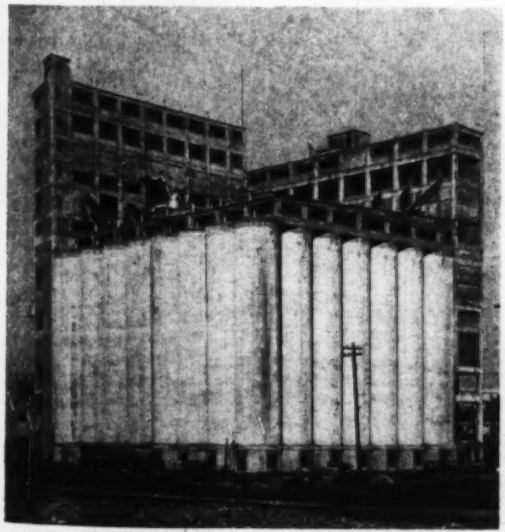
Telephone Building in San Francisco
A 26-story steel-frame structure being built by the American Telegraph & Telephone Co.

Ideal Section of the Lincoln Highway, Indiana
Lighting arrangement for test section of America's principal transcontinental motor road.

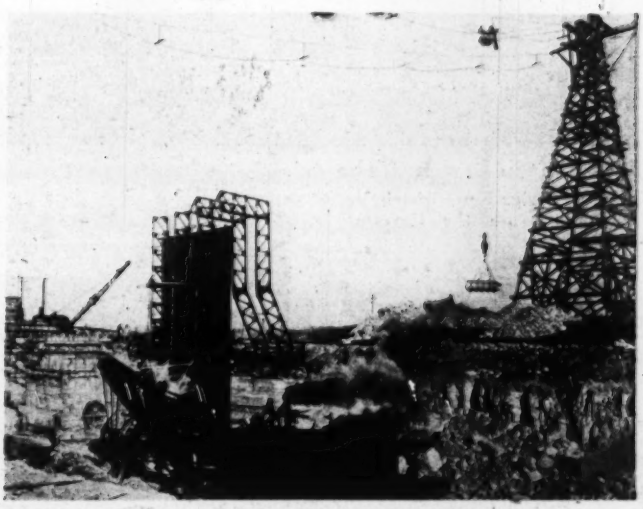
Schenectady-Scotia Bridge
Structure recently completed by the New York State Department of Public Works.

Subway Construction in New York City
Construction view of the Queensboro Extension at 42nd Street. (An article on this work is soon to appear in *Engineering News-Record.)*

Hydro-Electric Construction at Niagara Falls
Assembling one of the 70,000-hp. units for the Niagara Falls Power Co.



Terminal Grain Elevator, Vancouver, B. C.



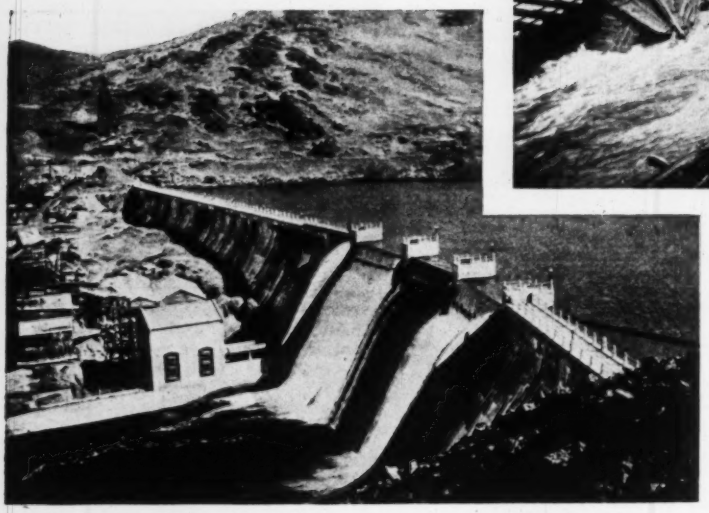
Building the Lockport Lock on the Illinois Waterway
The status of construction in December, 1924.

Sixteenth St. Bridge, Pittsburgh

Levee Work in Arkansas

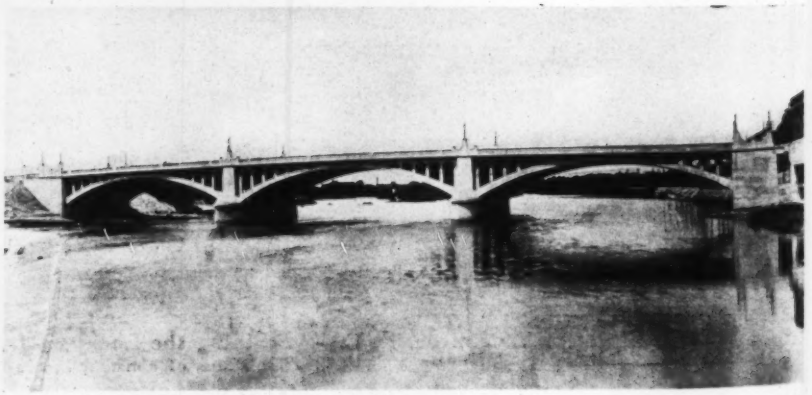
Lake Cushman Dam, Washington

Tacoma's municipal hydro-electric power development. Photograph shows damage done by flood waters.



Black Canyon Dam in Idaho

Emmett Irrigation District's Development on the Payette River.



Lorne Bridge, Brantford, Ont.

How Shall Our Highways Be Financed?

A résumé of the latest thinking — Bond issues vs. pay-as-you-go — How far shall automobile fees be used toward construction?

HIGHWAY construction in this country has reached, or at least is reaching toward, stability. The annual expenditure of around a billion dollars is close to the limit of the capacity for construction and the capacity to pay. It is probable, however, that for some years to come this amount of construction will be required to take care of the highway demands, constantly growing with the widening use of the automobile for pleasure, and what is more important, for business. This is a huge sum of money even for this prosperous nation, and the methods by which it is to be raised have to be examined with the closest scrutiny, not only to insure the proper distribution of the burden of cost but to safeguard the financial structure of the government subdivisions that must build and maintain roads and at the same time carry out other necessary governmental functions.

How is the enormous sum raised? An extensive survey was made by Henry R. Trumbower, economist of the Bureau of Public Roads, for the year 1921, and that is the last year on which there are accurate figures. In that year the state highway departments spent 36 per cent of the total, and the counties, townships and districts 64 per cent. Of this total, 38 per cent was raised by bond issues and 62 per cent by taxation, the states raising 28 per cent of their total by bonds and the minor subdivision 43 per cent of theirs. In the year 1921, too, motor vehicles paid taxes of one sort or another which totaled in amount 25 per cent of the total expenditure on all roads.

The amount paid by motor vehicles has, however, been gradually increasing. In 1914 federal and state special taxes on motor vehicles amounted to only 5 per cent of the total highway expenditure. In 1921, with the addition of the heavy excise taxes incident to the war, this percentage increased to about 25 per cent, and in 1923 it reached approximately 28 per cent. An estimate for the fiscal year 1924, by the National Automobile Chamber of Commerce, indicates that the total taxation paid by motor vehicles was $555,000,000. This half a billion dollars estimate is made up as follows: Federal taxes, including excise taxes on automobiles themselves and on parts and accessories and a $2,000,000 federal tax on passenger automobiles for hire, $160,000,000; state taxes total for registration fees, $225,000,000; gasoline taxes, $65,000,000; and personal property taxes, $90,000,000—making a total of $380,000,000 for the state. Municipal taxes were $15,000,000. The grand total is over 1923 by about 17 per cent. The total number of automobiles and motor trucks in the United States in 1923 was 15,092,000, and the estimated number in 1924, 17,000,000, an increase of about 2,000,000, or about 13 per cent.

A further pertinent fact is the heavy proportion of motor vehicle taxation that goes to the federal government. In 1924 (fiscal year) the government collected $160,000,000, and the Bureau of Public Roads reports that only about half of that amount was contributed by the government as its share of the federal-aid road system. It is likewise true that motor vehicle taxes are not uniformly applied to road construction in either state or minor division, but the practice is so diversified that it is impossible to give accurate figures on the proportion so applied.

The discussion on highway financing has two major questions: First, shall the money be raised by bond issue or by taxation; and second, how shall the taxation, direct and to amortize the bonds, be distributed? These two questions, with their numerous ramifications, are authoritatively discussed in two reports here abstracted. In general the conclusions are in agreement, though the National Tax Association report is more a reasoned development of the underlying economics and the joint highway officials and automobile association report is a basic statement of principles.

In brief they hold that total road expenditures must be budgeted on a combination of the traffic demands and the ability to raise funds, that bond issues must be used to meet the initial effort to provide adequate highway facilities, that the main line highways must be developed first, and that the principle of benefit rather than ability to pay must govern taxation for roads. In this latter contention the Tax Association report is particularly informing, and argues convincingly in favor of the restoration of a theory, somewhat outworn in other forms of taxation, that the direct user of public works should pay the major part of their cost. The extension of that principle is even carried, in both reports, to the point, hitherto opposed by the majority of the motor interests, of advocating the application of a portion of the motor vehicle tax to maintenance as well as construction. It may be noted that neither report refers to toll roads or bridges, except in passing, but that assessment-for-benefit is endorsed for special cases. The necessity for uniformity of tax practice, and for centralization of taxing agents and road control, is emphasized and, in the Tax Association report the taxing of vehicles by weight and by gasoline consumption are advocated. The whole highway financing situation is very complex but its successful working out will be hastened by the application of the principles which have been worked out in the two reports presented herewith.

Highway Transport Committee Report

The Highway Transport Committee is a joint committee of the American Association of State Highway Officials and the National Automobile Chamber of Commerce. The representatives of the State Highway Officials are: Thomas H. MacDonald, *chairman;* W. H. Connell, W. O. Hotchkiss, John A. Macdonald, J. N. Mackall, J. H. Mullen, and F. T. Sheets. The representatives of the Automobile Chamber of Commerce are: R. D. Chapin, *chairman;* George M. Graham, Alvan Macauley, Edward S. Jordan, Windsor T. White, A. J. Brosseau, and Pyke Johnson.

The abstract of the Highway Transport Committee report is as follows:

This report is predicated upon the recognition and acceptance of the general principles of outstanding importance:

1. The public demand for highways is now so great, and the funds involved so large, that is not possible to meet all demands in a limited period without too great a burden upon the public finance. Therefore, state funds available for new construction should be devoted first to the class of highways of greatest importance to the public under the jurisdiction of the state highway department.

2. The sum total of public roads should be considered, for financing purposes, in two major divisions: Group One, general service motor highways, i.e., general traffic flow lines; Group Two, local service roads.

3. Notice is taken of the extensive conversion of land that is taking place especially in populous districts, i.e., the changes in the actual or potential utilization of land in which the establishment or availability of motor transport is a major factor by which its value or its potential earning capacity is increased.

4. Notice is also taken of the special benefits which result from extraordinary highway undertakings in congested districts which may properly be financed, in part at least, by the formation of improvement districts with special assessments. As defined here, this principle is limited to conditions that are not average or normal, and does not apply to rural districts.

The following statement of principles records and outlines those policies which have already proven sound, and which at this time embody the best practice.

Highway Finance

1. The highway budget is defined as the total annual expenditures in each state for highway purposes.

2. The annual highway budget should be adjusted to the relative needs for other public purposes.

3. No road should be improved by expenditure of public funds in excess of its earning capacity. The return to the public in the form of economic transportation is the sole measure of the justification for the degree of improvement.

4. Broad surveys made by the United States Bureau of Public Roads have determined conclusively that from 40 to 60 per cent of the average costs of highway construction is expended in permanent improvements, such as grading, draining, structures, engineering and rights-of-way. Of the remaining cost, all but a small percentage of the surface can be salvaged in reconstruction and constitutes a definite addition to the capital facilities of the community which is passed on to the succeeding generations. From all these studies it thus appears that highway bond issues are justified where the "pay-as-you-go" plan does not promptly provide the highways economically necessary, and where adequate engineering and economic control is assured.

5. The wide variance in the present status of highway development in the several states prevents the adoption of uniform policies for securing the funds necessary for the annual budget. Generally speaking, however, these principles may be set forth:

(a) States in the initial stage of highway development should issue bonds to defer that portion of the annual charge for construction which would overburden either property or the road user.

(b) States where original construction programs are well under way, can, in the main, finance normal new construction from current funds utilizing bond issue funds to defer the cost of special projects.

(c) States where original construction is largely completed are concerned chiefly with maintenance and reconstruction, and should depend on current funds save in cases of emergency.

6. State highway bond issues should be serial in form and should mature over a period not exceeding thirty years.

7. Highway bonds issued by political subdivisions of a state should be serial in form and should mature over a period not exceeding twenty years.

8. Serial maturities should be arranged so that the annual requirements of principal and interest will be as nearly uniform as practicable.

9. Sound public financing requires that where motor vehicle or other special levies are allocated to defray the costs of state highway bond issues, the full taxing power also of the state shall be authorized to guarantee principal and interest in event of failure of such special levies to provide sufficient revenue.

Distribution of Costs

1. The cost of building and maintaining adequate systems of highways should be distributed in an equitable relation to the benefits derived. These may be summarized as follows:

(a) Benefits to society in general, such as influence on education, recreation, health, fire prevention, police protection, national defense, postal service, living costs.

(b) Benefits to definite groups, such as agriculture, manufacture, labor, railroads, mining, forestry and waterways.

(c) Benefits to property served.

(d) Benefits to the road user.

2. For the purpose of apportioning costs in relation to benefits received, all highways may be divided into two classes; first, those used by the general motoring public, and second, those which perform a purely local service function.

3. Special motor vehicle taxes should be levied and used only for the improvement and maintenance of highways used by the general public, i.e., for general highway traffic flow lines. They should be expended under the direction of the state highway department.

4. The wide variance in valuations, tax burdens, number of motor vehicles in use and the status of highway development in the several states prevents the adoption of any fixed formula as to the proportion of the total costs of highways of general use which should be paid for from motor vehicle funds. Generally speaking, however, these principles may be set forth:

(a) In states where the income from motor vehicles is insufficient to meet all of the maintenance costs of highways of general motor use without undue burden to the individual motorist, such funds should be applied first to inter-state and state highway systems.

(b) In states where the income from motor vehicles is sufficient to meet all maintenance costs of highways of general motor use without undue burden to the individual motorist, any surplus should be used for this class of reconstruction and administration costs.

(c) In states where the number of motor vehicles will bring in large sums in excess of maintenance without placing undue burdens upon the individual motorist, such surplus should be used to defray all the costs of maintenance and a substantial share of all of the other costs of highways of general motor use.

(d) In those states where the motor vehicle income is more than sufficient to meet maintenance costs of highways of general motor use without undue burden to the individual motorist, it may be found advisable to use such surplus for the purpose of defraying all or part of the costs of bond issues to expedite construction of economically desirable motor highways.

5. Roads of a purely local interest, serving only local needs, should be financed out of local revenues obtained from local general tax revenues. Special assessments on adjoining land to defray a portion of the costs of such roads may be justified.

6. Where extraordinary improvements are undertaken in the vicinity of or serving congested areas of population the increment, if any, in property valuation following the improvement should be drawn upon to defray an equitable portion of the cost.

Form of Motor Taxes and Collection Methods:

1. The motor vehicle tax should be simple in form and distributed in equitable and just proportion between the different types of motor vehicles.

2. The state should be the sole agency levying special taxes upon the motor vehicle or the highway user.

National Tax Association Report

The committee of the National Tax Association is composed of: Jacob Viner, *Chairman*, Associate Professor of Political Economy, University of Chicago; Thornton Alexander, Solicitor, Boston & Maine Railroad Co.; A. J. Brosseau, President, Mack Trucks, Inc.; C. C. Converse, Tax Commissioner of North Dakota; Maurice Groshon, Chairman, State Board of Equaliza-

tion, Wyoming; W. H. Maltbie, Counsel, American Electric Railway Association, and W. G. Query, Chairman, South Carolina Tax Commission.

The abstract of that part of the report dealing with financing is as follows:

Borrowing vs. Pay-as-you-go—Maintenance expenditures should be sufficient to preserve the improvement in as good shape as when first constructed. The generally accepted rule that the maturity of bonds for financing improvements should not extend beyond the life of the improvement fails, therefore, to set an adequate limit to the resort to borrowing to finance highway construction, and guidance must be sought in more fundamental principles, in determining the extent to which borrowing is justified.

During the initial period of construction of an extensive system of improved highways, densely populated and rapidly growing states, and states where the immediate need for the construction of improved highways is urgent, it would be unwise to attempt to finance highway construction wholly or even in large part from current tax revenues. If current revenues are relied upon under these circumstances, there will result either an intolerable tax burden on the community or else there will be an unreasonable retardation of highway construction, entailing to the community the loss for many years of the advantages of improved means of highway communication. Such a financial policy would be likely to lead, moreover, to piecemeal construction, with the result that the utility of each mile of improved road will for many years be reduced, as compared to the possibilities if, once the system were carefully planned, a program of rapid completion of its general framework were embarked upon. States and localities, however, which have already made considerable progress in highway construction and have already passed the peak of new annual mileage, should move gradually toward the pay-as-you-go basis. This could be accomplished, partly by shortening the maturity of new bond issues and partly by increasing the proportion of new construction costs met out of current revenues. Maintenance and reconstruction costs should, under all normal circumstances, except perhaps where the reconstruction involves a substantial improvement in the more permanent features of the old road, be financed from current revenues.

Loans incurred for highway construction should not have a longer maturity than thirty years, and preferably not more than twenty years, and should be of the serial bond type. Resort to bond issues, with excessively long maturities, is liable to stimulate reckless and wasteful expenditures, since the resistance of the taxpayer to bond issues is much less than to increases in tax levies. In any case, there is comparatively little advantage in the annual cost during the first twenty years, of paying for an improvement on a twenty- as compared to a forty-year basis, but there is a tremendous difference at the end of the twenty years, depending upon whether the one maturity or the other had been chosen. The accumulation of debt, without provision for its early liquidation, impairs the credit of the borrowing agency and if funds are later needed for emergencies or for the new activities which democracy is constantly demanding of government, they will not be obtainable or will be obtainable only at usurious rates. We cannot see clearly enough into the future to be certain that new transportation needs or facilities may not develop which will render obsolete much of our present huge investment in automobile roads.

Principles of Highway Taxation—Today there survive only slight traces, here and there, confined largely to bridges, of the once-dominant toll system. The advent of the automobile brought the need of a greatly improved and extended highway system and threw upon the state and local governments a great additional financial burden which, because of their inadequate and obsolete revenue systems, they were ill-prepared to assume. A partial solution was sought in a return to the benefit principle of taxation, a part of the cost of highway financing being thrown on the direct users of the highways, but in the form of special automobile license or registry taxes, and in the last few years, of gasoline taxes, without resort again to the abandoned toll system. The tendency toward imposing on highway users an increasing portion of the cost of highways is becoming more marked each year. The time is rapidly approaching when special motor vehicle taxes will equal the expenditures on highways, both primary and local, from current tax receipts.

The varying circumstances in which different states find themselves, with respect to highway burdens, and the fact also that American public finance is not governed to any important extent by formulas, meritorious or otherwise, but is largely the product of historical traditions, inertia, and the play of political factors, make it academic to present any rigid formula as the proper solution of the problem of apportionment of highway costs. Your committee is not prepared to recommend any fixed percentage of total highway expenditures as the proper percentage to be financed by special taxation of motor vehicles. But for all states, except those at the very inception of their program of improved highway construction, special taxes on highway users should be sufficient to defray a substantial part of the costs of construction and of interest on highway indebtedness, as well as all of the maintenance costs of primary highways. The tendency in highway finance is strongly in the direction of placing on highway users an increasing proportion of the burden of highway finance. We approve of this tendency, not only as an inevitable resultant of the pressure of facts, but as thoroughly consistent with equity and with expediency.

Roads of a purely local interest, serving only local needs, should be financed out of local revenues, obtained either from local general tax revenues or from special assessments on adjoining land. When such local roads, however, are improved and absorbed into the state highway system and lose their purely local character, they should be financed out of state funds, derived mainly from motor vehicle taxes. Special assessments ordinarily have no place in the financing of primary roads. They should be used in connection with the financing of local roads, only to meet part of the construction cost and the amount of the assessment should never be greater than the increase in the market value of the adjoining land which would unmistakably and immediately result from the improvement.

Special motor vehicle taxes for highway purposes represent a return to the principle that those who derive direct benefit from government services should contribute to the cost of such services, in proportion to their benefit therefrom. Some modern writers on public finance have largely thrown this principle overboard, and find little or no proper scope for its application beyond its limited use in the levy of fees and special assessments. The trend of taxation practice for other than highway activities has during the last few generations also been decidedly away from the benefit principle and toward the principle that government services should be made freely available to all and should be financed by taxation according to ability. The field of highway finance presents almost the only instance—if not actually the only one—in modern American financial history, of the sharp reversal of the trend from benefit taxes to ability taxes. Is this reversal of the trend justified? If so, has it gone too far or should it go still further?

Why Benefit Principle Was Abandoned.—The abandonment of the benefit principle was due in the main to the influence of the modern concept of the social solidarity of the people, which appeared to justify the policy of requiring the more prosperous classes to pay the cost of services which the poorer classes would in large part enjoy. Under the influence of popular pressure, governments extended their functions so as to include new types of activities, expensive to finance and many of them distinctly serving the masses of the people rather than the wealthier classes. The poor could not afford to meet the cost of these new activities, without making serious sacrifices. The main objects and results of the shift from the benefit to the ability principle were, therefore, (1) to enable the government to provide for the masses, services whose costs the latter could not or would not directly defray, and (2) to shift the burden of financially supporting the more general activities of government from the population as a whole to the relatively wealthy classes.

To the extent that the great rise in highway expenditures has been incurred on behalf of the non-industrial automobile use of roads, the ordinary argument for the application of the ability principle fails altogether to apply. There is not any problem here of making a government service freely

available to the poorer classes, who otherwise could not afford to avail themselves thereof. The really powerful arguments against the benefit principle of taxation, namely, that it shifts burdens to those who are not able to bear them and that it therefore makes impossible the financing of such government activities as are predominantly for the direct benefit of the masses, have, therefore, a narrowly limited applicability to this phase of the modern problem of the financing of automobile highways.

In the case of commercial and industrial automobile use of highways, the situation is not essentially different. The benefits of the improved primary highways accrue immediately to the automobile owners, in the form of lower transportation costs, and will in general be passed on to consumers in the form of lower prices or else will be absorbed as extra profits by the producers or the owners of productive property. To the extent that the general public shares in the benefits of cheaper transportation, special taxation of highway users will be passed on to them. In the last analysis, owners of industrial automobiles will shift any special automobile taxes imposed on them to those who derive the economic benefit from the highway improvements.

Why Benefit Principle Is Desirable — There can be no reasonable ground for doubt that the direct benefits from highway improvements go in the first instance to the automobile owners or to those who are directly served by automobile transportation. These are not, of course, the sole beneficiaries of the highways, but they are by far the chief ones. That there are secondary benefits from the use of highways, which accrue to others than those immediately served by highway transportation, is not a valid objection to the financing of highways on the benefit principle. No one would contend, because there are secondary benefits from the existence of a suitable water supply, which accrue to others than those who actually make use of the water service, that it is unfair to finance a municipal waterworks by special charges on those who are directly served by it. If any municipality ever departs from the benefit principle in financing its waterworks, it is not because of the existence of indirect and secondary benefits to the general community from the water system, important as these are, but to relieve the poorer classes of the necessity of meeting the cost of the direct benefits accruing to them. Where electric or steam railroads are operated by the state, it has not been generally regarded as inequitable to the direct users of these public works, that the special charges to users should be sufficient to finance the enterprises. But these are indirect and secondary benefits accruing to others than the direct users, in the case of railroad transportation, as much as in the case of highway transportation.

Were the issue in the case of highway finance really between the ability principle and the benefit principle, it would not much matter, in so far as the equitable distribution of the burden of highway costs was concerned, which method was chosen, since either method would, in the ultimate analysis, probably result in about the same distribution of taxes. But the real alternative in state and local highway finance in the United States is between the benefit principle and the general property tax. It has been repeatedly disclosed by careful investigators that the general property tax works out in practice at a higher rate on small parcels of property than on large. A large fraction of the property tax on improved real estate and on personal property, moreover, is unquestionably shifted by the first taxpayer to the masses of the population, in the form of higher house rents and higher prices for commodities and services. It is altogether probable that with the existing distribution of ownership of automobiles, the financing of primary highways by special taxes on highway-users will conform more closely to the ability principle than will the resort to the general tax revenues of state and local governments for highway funds.

The argument from expediency also justifies the resort to automobile taxation as a means of financing highways. In most of the American commonwealths the existing revenue systems are already strained to the utmost to meet the calls for revenue from the expanding programs of government activity. The tax burdens on real estate and on the farmers in general are already as great as they can reasonably be expected to be able to bear. The great need in state and local finance is the discovery and adoption of means to lighten the tax load on the overburdened classes. To finance highway expenditures out of general revenues means in practice to finance them by additional taxes on tangible property real and personal. Under existing conditions it is much more equitable to place the burden of highway finance on those who use the highways in proportion to their use, rather than on property owners, irrespective of their use of the highways.

Automobile Tax Not Burdensome—The payment by highway users of all maintenance costs of primary highways and of a substantial portion of construction costs and interest on indebtedness incurred in the construction of primary highways is well within the limits of their reasonable capacity. The motor vehicle registrations in 1923 in the United States totaled 15,092,000 and will undoubtedly pass the 17,000,000 mark in 1924. The average levy per automobile, which would pay all maintenance and interest costs and would provide a generous fund for amortization of construction costs of primary roads would not greatly exceed the average special tax burden per automobile now imposed. The annual registration of automobiles is increasing more rapidly than the annual highway expenditures, so that the average levy per automobile which would be necessary to finance all the highway costs, for *secondary* as well as primary roads, is progressively diminishing. If the expenditures of automobilists on the upkeep of their cars, on gasoline, and on garage hire be considered, it is not unreasonable to hold that an annual levy, adequate fully to meet the program laid down in this report, would not be beyond their ability to pay and would not exert an appreciable adverse influence on the rate of development of automobile transportation.

While your committee does not recommend that the cost of purely local roads should be met by special motor-vehicle taxation and while it does not regard it as immediately practicable that even all primary road costs should be financed by motor-vehicle taxes, it regards with approval what appears to be a tendency in this direction and welcomes progress toward that goal, especially for states and counties which have completed or are approaching the completion of the construction of their primary system of improved highways.

Apportionment Between Federal, State and Local — We urge the importance of centralized control over the planning, construction and maintenance of primary roads. But under the American type of political organization, no great measure of centralization of financial control is feasible, unless it is accompanied by the assumption on the part of the central authority of a substantial measure of responsibility for financing the activity in question. Except through centralized financing, moreover, it is impossible to apportion the costs of a co-ordinated highway system, in even rough accordance with the territorial distribution of benefits from highways or with the territorial distribution of ability to pay.

Federal aid to highways has been valuable under these circumstances. By its highway grants the federal government has secured the opportunity of giving advice, of laying down minimum engineering standards of construction and maintenance, of assuring the development of a nationally co-ordinated highway system, and also of lightening the burden for those states of sparse population and long distances, which are crossed by important national automobile routes, but which could not reasonably be expected to meet the full cost thereof from state and local revenues. It is important that federal aid should never be given, without conditions being attached which will assure their proper utilization, but the administration of federal highway aid by the federal bureau of public roads, under the able direction of Thomas H. MacDonald has been of a highly satisfactory character and is entitled to the commendation of all who are interested in the full and scientific development of the American highway system.

The federal government has collected in special taxes on motor vehicles and parts, to June 30, 1923, a total of $589,012,000, but during the same period has spent on highway aid to the states and on forest roads, including administrative expenses, a total of $264,782,000, or only 45 per cent of the receipts from motor-vehicle taxes. Your committee recommends that the federal government should derive the revenues which it devotes to highways from the special

taxation of highway users, Mr. Brosseau, however, dissenting. These federal taxes should, if possible, take some form other than an ad valorem tax. To the extent that its aid is granted to projects constructed primarily to serve the purpose of national defense or to open backward regions to colonization, the federal government would be justified in using funds derived from general tax revenues. But the federal government should not levy taxes on motor vehicles as such in excess of what it spends on highways. The reduction in the taxes on motor vehicles and on motor vehicle parts effected by the Revenue Act of 1924 meets, therefore, with our approval. We recommend the total elimination of the remaining federal excise taxes on motor vehicle parts.

Similar considerations to those discussed above, in connection with the relation between federal and state highway finance, apply with even greater force to the relation between the states and the political subdivisions.

For purposes of highway finance, roads should be classified as local and primary highways, according to whether they serve purely local needs or the needs of wider areas. Local roads should alone be financed by the locality, whereas primary roads, serving a wider area, should be financed by the state. The principle here is sound in theory but is difficult of application. As the extension and improvement of the highway system progresses, it approaches ever more closely to being a unified whole, requiring control and financing on that basis. It is desirable, therefore, and it becomes more urgent with every expansion of the highway system, that highway costs be met as far as possible from state revenues, derived from state taxes, uniformly levied throughout the state. It is impossible to render exact justice as between the different localities, but the nearest approximation thereto can be made, especially as between, on the one hand, sparsely settled or poor rural districts, through which run expensive primary highways, and on the other hand, the urban centers, which provide much of the traffic for these highways, if the state government assumes the entire burden of financing primary highways, leaving to the counties the financing out of local tax revenues of local roads not constructed or maintained in condition to be satisfactory for through motor traffic or used solely, or almost so, by traffic originating and terminating within the immediate locality.

Where the state provides all or part of the funds for financing the primary highway system but the actual expenditures are made by the local governments, careful consideration should be given to the mode of apportionment of the state aid to the local governments.

Motor Vehicle Taxes—If only one motor vehicle tax were to be levied, the gasoline tax would appear to be preferable to the registration tax. The factors of most importance in estimating the costs accruing to the state from automobile traffic are the mileage traveled, the gross weight of the vehicle, and the speed at which it is driven, and the amount of fuel consumed reflects in some measure all of these factors. The gasoline tax is conveniently paid, easily collected and easily administered. It is the only practicable mode of reaching highway users from other states than that levying the tax. Even where the tax is opposed at first by motorists it wins their approval, or at least their toleration, after it has been in effect for some time and they have grown accustomed to it.

Registration taxes appear to be necessary, even where gasoline taxes are in effect, in connection with the regulation of motor vehicle ownership and operation. They also are useful, because they can be devised to take more fully into account the influence of weight of car, weight of load and type of tire on highway wear and tear, than does fuel consumption. A further factor in favor of the levy of registration taxes, even when gasoline taxes are levied, is that highways in general are constructed on a scale sufficient to accommodate the peak load of traffic and an automobile which is in the garage most of the year, and therefore consumes little gasoline, but is operated on the highways when traffic is at its peak, escapes its due share of taxes if it is taxed only on its gasoline consumption. A greater measure of uniformity between the states in the bases used for levying registration taxes is, however, highly desirable.

Gross weight, by which is meant the weight of the vehicle loaded with a standard load, is the best, as it is the simplest base. Where weight or gross weight is used as the basis of taxation, your committee recommends that the rate of tax, per unit of weight, should be graded upwards as weight increases, the graduation of rates to be determined on the basis of engineers' tests of the comparative wear and tear on the roads and use of road space per ton of the different weight vehicles. Since the primary purpose of motor vehicle taxation now is to make the highway user meet in whole or in part the cost of the construction and maintenance of automobile highways, there is no justification for registration taxes which take into account the value of the vehicle, such as advalorem taxes, taxes which make allowance for the depreciation of the vehicle, or horsepower taxes, intended to reflect the value of the vehicle. Even though there may be some relation between value of the vehicle and wear and tear on the roads, the latter can be better taken into account by other means than through taxation on the basis of value or some index of value. It is not reasonable to ask that the rates of tax, whether for gasoline taxes or for registration taxes, should be uniform as between the states, since the different financial requirements for highway purposes of the different states justify different rates of taxation. It is recommended, however, that each state, before fixing its rates of taxation, should survey the financial requirements for highway construction, interest on highway indebtedness and highway maintenance (including its grants in aid to the counties and after allowance for what is to be received as federal highway aid), should determine what proportion of its highway expenditures is to be met by motor vehicle taxation and should adjust the rates accordingly. It is also recommended that the counties levy no charges in connection with chauffeurs' or operators' licenses and that the states levy no such charges, other than very moderate license fees not exceeding $1 each.

The levy of ad valorem rates on automobiles as personal property under the general property tax is not considered to be a special tax on motor vehicles or to have any direct relation with the problem of highway finance, and is therefore not regarded as falling within the scope of our report. Where motor vehicle registration taxes are levied in lieu of personal property taxes, only such parts of the registration tax revenues are to be regarded as special taxes on highway users as are in excess of the amounts which automobiles would pay under the personal property tax, if they were not exempt therefrom.

Disposal of Motor Taxes—There is no uniformity in usage as between the states in the disposal of revenues from special taxes on motor vehicles. In most of the states they are used solely or mainly for highway purposes, but in some states important fractions thereof are diverted to other than highway purposes. Some states segregate their motor vehicle tax funds for construction purposes, others for the payment of interest on and the amortization of highway indebtedness, others for road maintenance expenses, and still others reserve them for highway purposes in general, without further statutory specification. Many states distribute the proceeds of the motor vehicle taxes in part to the counties; other states reserve them wholly for state use.

Your committee recommends that each state determine what proportion of its highway expenditures it proposes to finance from the proceeds of special taxes on motor vehicles and that it do not levy taxes on motor vehicles in excess of the rates necessary to produce such amounts of revenue, and it further recommends that in no instance shall the special taxes on motor vehicles exceed in amount the total highway expenditures of the state, after deduction of the amounts received as federal highway aid, but including the amounts distributed to the counties for highway purposes. Your committee cannot recommend, however, the rigid segregation by statute of the proceeds of motor vehicle taxes for use solely for highway purposes. Segregated treasury funds increase the interest expense of the government, by cutting down the supply of available cash. It is important for the economical administration of state funds, that special funds be eliminated entirely and that all receipts be placed in one general account. The proper balancing of highway expenditures and motor vehicle tax revenues should be provided for in the preparation of the state budgets rather than by rigid statutory requirements.

Principal Hydro-Electric Developments: 1924

IN ORDER to make it easier to visualize the extent of the water power developments completed or under construction in 1924 in this country and Canada the tabulation of such projects which was begun last year has been continued in the table reproduced below. Power developments which were listed in last year's table (Jan. 3, 1924, p. 32) are not repeated here except in such cases as Muscle Shoals, Nipigon and the Queenston-Chippawa plant where additional turbine installations have been authorized, and such cases as the Wallenpaupack development of the Pennsylvania Power & Light Co. where detailed information was lacking last year.

Certain plants listed for completion in 1924 in the 1923 table will not be completed until 1925. With these revisions the total new water brought into service in 1924 amounts to 1,100,000 hp. for the United States and 660,000 hp. for Canada.

UNITED STATES

Company	Plant	Horsepower — Units	Unit Capacity	Total New Installation	Head	Year of Operation
Adirondack Power & Light Co. (N. Y.)	Beardslee Falls	..	.....	26,600	...	1924
Alpena Power Co. (Mich.)	Norway Point	..	.....	6,400	...	1924
Andrews Municipal (N. C.)	.....	..	.....	2,000	...	1924
Augusta-Aiken Ry. & Elec. Corp. (Ga.)	Stevens Creek	..	.....	*4,000	...	1925
Arkansas Power & Light Co.	Remmel	..	.....	24,000	...	1925
California-Oregon Power Co.	Copco No. 2	2	20,000	40,000	140	1925
Citizens Gas & Electric (Iowa)	Waterloo	..	.....	1,400	...	1924
Consumers Power Co. (Mich.)	.....	2	12,000	24,000	...	1925
Colorado Springs, Municipal	.....	1	1,450	1,450	...	1925
Columbus Electric & Power Co. (Ga.)	Bartlett's Ferry	..	.....	40,000	...	1926
Detroit Edison Co. (Mich.)	French Landing	..	.....	4,300	...	1925
Georgia Ry. & Power Co.	Terrora	..	.....	20,000	...	1925
Georgia Ry. & Power Co.	Tugaloo	..	.....	88,000	152	1924
Georgia Ry. & Power Co.	Yonah	..	.....	45,000	94	1925
Holyoke Water Power Co. (Mass.)	Conn. Riv. No. 2	3	1,500	4,500	...	1925
Illinois Northern Utilities Co.	Dixon	5	800	4,000	8	1925
Indiana Hydro-Electric Power Co.	Oakdale	..	.....	18,000	...	1925
Lake Superior District Power Co. (Wis.)	Ashland	..	.....	*10,000	...	1924
Manchester Traction, Light & Power Co. (N. H.)	Garvins Falls	2	.....	8,200	30	1924
Merced Irrigation District (Calif.)	Exchequer	2	24,500	49,000	300	1925
Minnesota Power & Light Co.	Blanchard Rapids	2	8,000	16,000	45	1925
Minnesota Power & Light Co.	Fond du Lac	1	15,000	15,000	...	1924
Northeastern Iowa Power Co.	Cedar River	..	.....	.....	...	1925
Northern New York Utilities	Soft Maple	2	10,500	21,000	121	1925
Northern New York Utilities	Sewell's Island	..	.....	3,000	...	1925
Northern States Power Co. (Minn.)	Red Lake Falls	..	.....	1,000	...	1924
Northern States Power Co. (Minn.)	Twin Cities	..	.....	6,600	...	1925
Northwestern Electric Co. (Wash.)	Yale	2	20,000	40,000	140	1926
Pennsylvania Public Service Corp. (Md.)	Deep Creek	..	.....	24,000	437	1925
Pennsylvania Power & Light Co.	Wallenpaupack	2	28,500	57,000	330	1926
Puget Sound Power & Light Co. (Wash.)	Baker River No. 1	2	20,000	40,000	228	1925
Puget Sound Power & Light Co. (Wash.)	White River	1	23,000	*23,000	440	1924
Salt River Valley Water Users Assn. (Ariz.)	Horse Mesa	3	15,300	45,900	264	1926
Southern California Edison Co.	Big Creek No. 1	1	35,000	*35,000	1,900	1925
Southern California Edison Co.	Big Creek No. 2	1	22,500	*22,500	...	1924
Southern Nebraska Power Co. (Neb.)	Republican River	..	.....	.....	...	1925
Southern Power Co. (S. C.)	Catawba River	4	20,000	80,000	200	1925
Southern Power Co. (N. C.)	Rhodhiss	..	.....	40,000	...	...
Southern Sierras Power Co.	Adams	1	7,500	7,500	221	1924
Tacoma Municipal (Wash.)	Cushman	2	19,000	38,000	250	1925
Tallassee Power Co (N. C.)	Badin	..	.....	31,000	...	...
Turlock Irrigation Dist. (Calif.)	Grange	..	.....	5,300	...	1925
Utah Power & Light Co.	Cutler	2	21,000	42,000	...	1926
United States Government (Tenn.)	Muscle Shoals	4	35,000	*140,000	...	1925
Wisconsin Public Service	Caldron Falls	..	.....	12,400	...	1925
Wisconsin Valley Electric Co.	Alexander Dam	..	.....	7,500	...	1924

CANADA

Backus-Brooks (Ont.)	Kenora	4	1,200	4,800	...	1924
East Kootenay Power Co. (B. C.)	Elko	..	.....	15,000	...	1924
Great Northern Power Co. (Ont.)	Indian Chute	2	2,000	4,000	48	1924
Laurentian Hydro-Electric Power Co. (Que.)	St. Marguerite	1	2,000	2,000	...	1924
Montreal Light, Heat & Power Co. (Que.)	Cedars Rapids	2	11,300	*22,600	...	1924
Nova Scotia Power Commission	Ruth Falls	2	3,000	6,000	109	1925
Ontario Hydro-Electric Power Comm.	Trent No. 9	3	1,600	4,800	...	1925
Ontario Hydro-Electric Power Comm.	South Falls	..	.....	*5,800	...	1924
Ontario Hydro-Electric Power Comm.	Nipissing	1	1,300	*1,300	...	1924
Ontario Hydro-Electric Power Comm.	Nipigon	2	12,500	*25,000	...	1925
Ontario Hydro-Electric Power Comm.	Bingham Chute	2	650	1,300	...	1925
Ontario Hydro-Electric Power Comm.	Queenston-Chippawa	3	55,000	165,000	305	1924
Shawinigan Water & Power Co.	St. Narcisse	2	10,000	20,000	...	1926
Southern Canada Power Co.	Drummondville	2	6,000	*12,000	30	1925
United Town Electric Co. (Nfld.)	Seal Cove	1	1,500	1,500	180	1924

*Additional installations in existing plants.

E. N.-R. Statistics of Cost and Volume

Construction's Record Year—1924

WHEN last year's returns showed that construction contracts in all classes and of all sizes totaled $6,000,000,000, then 1923 was rightly called the record year. This figure included $2,112,000,000 worth of residential buildings and as much of comparatively small work. The year just past has exceeded even that record.

Engineering News-Record, in its Construction News Section, is concerned only with projects that present engineering problems. They must reach these minimum costs: water-works, excavation, dredging and irrigation, $15,000; other public work, $25,000; industrial buildings, $40,000; commercial buildings, $150,000.

The 115 Construction News correspondents located in the strategic centers of the United States report 600 to 800 jobs of the costs named each week. These are reported in four stages: proposed, bids desired, bids received, and contracts awarded. Awards alone average $40,000,000 per week. The U. S. total for 1924 was $2,002,533,000, against $1,899,254,000 in 1923. Hence, 1924 is now the record year.

But the year just past makes a record not only in money value of contracts awarded. It has also set a new mark in actual physical volume of engineering construction placed under contract. In terms of the 1913 dollar, 54 per cent more construction was definitely authorized than in that first pre-war year. This fact is established by the *Engineering News-Record* Construction Volume Index Number.

The gains were in water-works, sewers, streets and roads, commercial buildings and construction of such varied and scattered nature as to be designated unclassified, such as tunnels, wharves, stadiums, grain elevators, retaining walls and all other structures that go to round out construction. "Unclassified," with a minimum cost per job of $25,000, aggregated $205,000,000 compared with $182,000,000 last year.

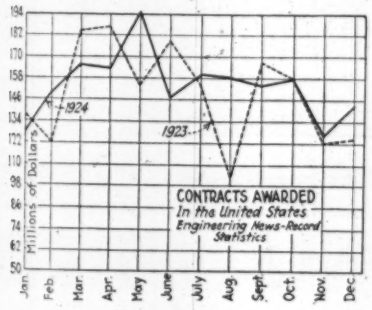
The gains noted were in three major sections of the country: New England, the Middle Atlantic states, and the South. The greatest increase was in the Middle Atlantic states—24 per cent over 1923. The chief loss was in the Middle West—down 11 per cent. Canada just about held her own.

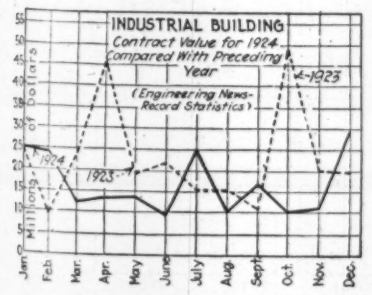
December, just past, developed a remarkable recovery. It is the strongest December on record—8 per cent above December, 1922, its nearest competitior.

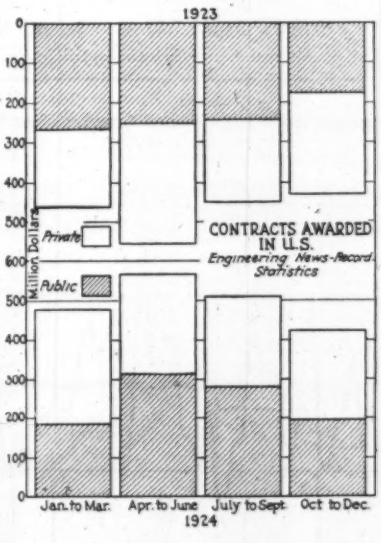
A chief source of information as to the degree of confidence business places in itself and the public is the amount of money being spent for actual physical expansion of industry. In 1923, six hundred million dollars went into new factories, power development, machine shops, and extensions in the process industries; in 1924, not quite half a billion. The December total is 50 per cent heavier than that of December, 1923.

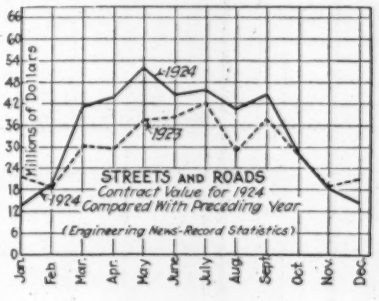
VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA DURING THE ENTIRE YEAR 1924

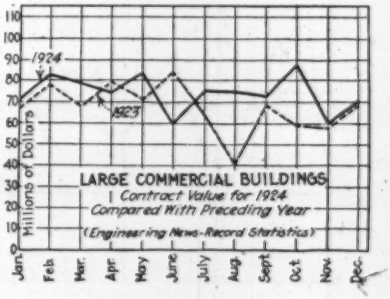
	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States	Canada	Grand Total
Water-works	$4,284,000	$8,485,000	$6,783,000	$13,047,000	$20,124,000	$8,722,000	$61,445,000	$4,007,000	$65,452,000
Sewers	1,203,000	25,402,000	4,463,000	21,613,000	12,068,000	9,804,000	74,553,000	3,626,000	78,179,000
Bridges	3,371,000	17,259,000	7,627,000	10,507,000	16,833,000	12,967,000	68,564,000	1,364,000	69,928,000
Excavation, drainage and irrigation	684,000	1,522,000	8,541,000	785,000	8,766,000	6,531,000	26,829,000	21,461,000	48,290,000
Streets and roads	15,231,000	84,193,000	79,061,000	91,959,000	98,250,000	46,522,000	415,216,000	15,105,000	430,321,000
Industrial buildings	25,794,000	54,469,000	19,355,000	56,324,000	22,976,000	26,051,000	204,969,000	8,485,000	213,454,000
Commercial buildings	95,846,000	338,766,000	52,555,000	211,666,000	120,835,000	115,237,000	934,905,000	20,926,000	955,831,000
Federal Government	1,334,000	9,511,000	12,821,000	3,213,000	4,380,000	7,626,000	38,885,000		38,885,000
Unclassified	3,809,000	64,969,000	16,865,000	21,925,000	36,390,000	33,209,000	177,167,000	27,949,000	205,116,000
Total entire year 1924	$151,556,000	$604,576,000	$208,071,000	$431,039,000	$340,622,000	$266,669,000	$2,002,533,000	$102,923,000	$2,105,456,000











A New Index Number of Construction Volume

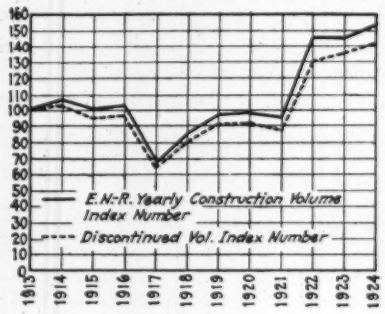
E. N.-R. Statistics

THE *Engineering News-Record* Construction Volume Index Number has been recast for the years 1913 to date. The new number plotted on the accompanying chart is slightly lower than the old. The recasting has been dictated by two things—first, the desirability of basing the number entirely on United States construction, excluding the Canadian figures hitherto included; and second, the desirability of ironing out discrepancies due to the occurrence of a five-week month four times a year.

The *Engineering News-Record* Construction Volume Index Number is an index relation between the volume of construction recorded in any year or its fraction, and the volume recorded in the year 1913 or its corresponding fraction. The total volume of construction is in all cases the aggregate value of important constracts awarded in the United States as reported in the Construction News Section of *Engineering News-Record* which considers as "important contracts" those above the following limits: Water-works and excavation, $15,000; other public works, $25,000; industrial buildings, $40,000; commercial buildings, $150,000.

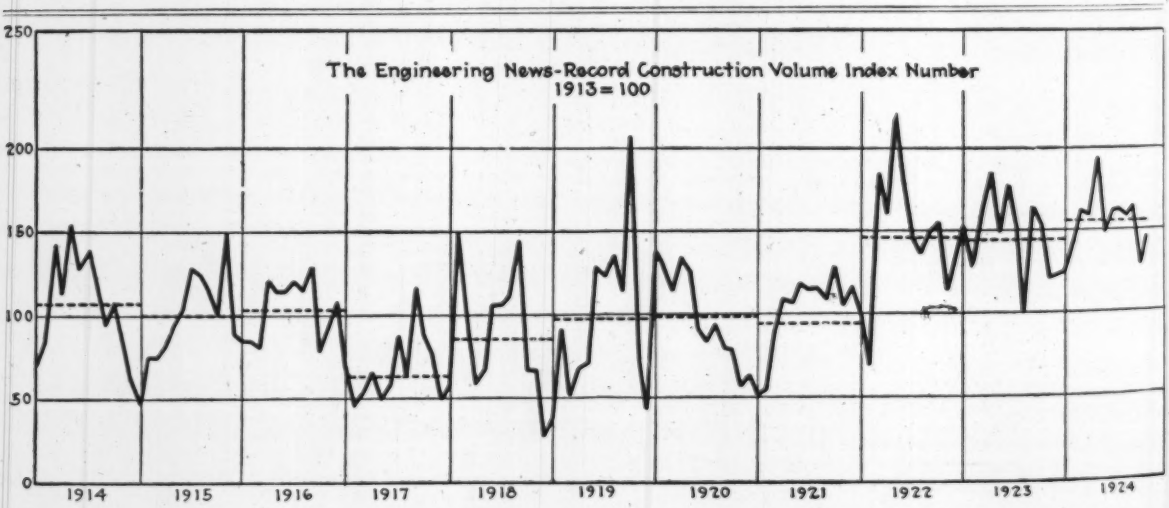
The Volume Index hitherto reported in these columns was based on the total volume of construction in 1913 including the Canadian construction. It has since been found that 1913 Canadian construction was exceedingly high and out of all proportion to its later relation to United States construction. In order, therefore, to present a proper index of United States construction the value of Canadian construction has been eliminated from the number, thus changing both the 1913 base and values for subsequent years.

The second necessity for a revision comes from the fact that once every three months there is a month with five Thursdays in it (Thursday being the publication day of *Engineering News-Record*). The volume of construction, therefore, has varied unreasonably from month to month and it has been necessary in plotting the Volume Index to multiply the values in these extra-week months to ⅘ in order to make them comparable with the other months. The new Volume Index has been devised on the basis of an average issue of any month whether that month has four of five issues. The base, therefore, is the aggregate value of all contracts awarded in the United States in 1913 divided by 52, and the base for any comparable later month is the total value of important contracts awarded in that month di-



Engineering News-Record Construction Volume Index Number—1914 to 1924

	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
January	71	48	84	69	57	38	138	52	100	151	125
February	83	76	84	47	151	91	130	55	68	129	144
March	142	75	80	55	90	52	113	90	186	162	161
April	113	82	121	65	58	78	134	109	161	186	159
May	155	96	114	50	67	80	126	108	221	149	194
June	128	105	113	57	106	129	92	119	178	173	149
July	139	129	120	87	107	122	83	115	146	151	161
August	118	126	115	63	111	135	86	116	137	100	162
September	95	116	128	116	145	113	80	109	149	166	159
October	108	101	78	87	67	207	79	130	154	154	164
November	84	150	94	76	66	71	57	106	114	121	128
December	62	89	107	49	27	41	63	117	134	123	145
Yearly	107	100	103	67	86	98	99	96	147	146	154



of Cost and Volume

vided by the number of issues of *Engineering News-Record* in that month. The volume for any period later than 1913 is further adjusted by reducing it to the 1913 base in proportion to the relation between construction costs in that period and in 1913; in other words by applying the *Engineering News-Record* Construction Cost Index.

In the 52 weeks of 1913 *Engineering News-Record* reported awards in the United States to the value of $601,405,000. The average week, therefore, is taken as $11,600,000. To compute the December, 1924, Volume Index Number, for example, the total value of awards in that month—($141,016,000)—is divided by the number of issues of Construction News (4). This gives the average week for the month of December, 1924 ($35,254,000). To reach a comparable cost basis, this value is divided by the *Engineering News-Record* Construction Cost Index Number of the following month expressed as a decimal (2.10). This result ($16,768,000) is divided by the base ($11,600,000), giving the December Volume Index (145).

E.N.-R. Construction Cost Index —Derivation and Values

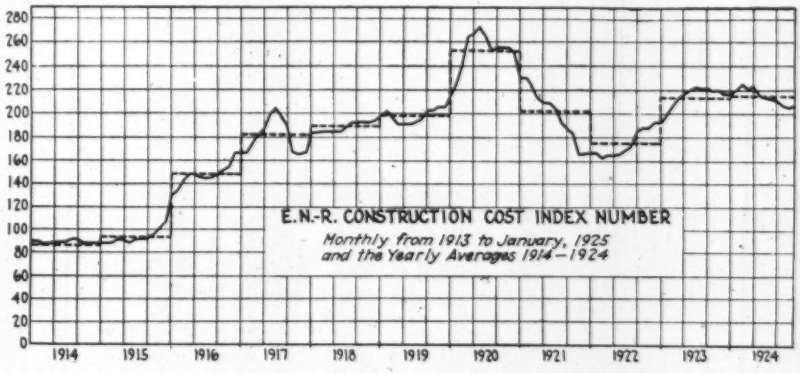
ENGINEERING NEWS-RECORD'S Construction Cost Index is a national index of general construction cost in the United States. For that reason in its computation only the great basic materials and common labor are considered. Steel, cement and lumber are the fundamental materials of the construction industry, and the rate paid common labor eventually determines the cost of labor.

The importance of the cost of brick, sand, gravel, crushed stone, and the rest is not minimized; but these materials are usually produced locally and their prices are subject to fluctuating local conditions.

The *Engineering News-Record* Construction Cost Index Number is not referred to Boston or Seattle, to Minneapolis or El Paso, but to the 3,507,640 sq.mi. of the United States. Change in towing rates on the Hudson River will affect the price of brick or crushed stone, alongside dock, New York, without making any change whatever in the nationwide cost of construction. On the other hand, a price movement in either steel, cement or lumber wields an influence that is almost invariably continental in scope.

The *Engineering News-Record* Construction Cost Index Number is based on the prices of steel, cement, lumber and common labor in 1913. Furthermore, these materials and common labor are weighted according to their relative importance as adjudged by *Engineering News-Record*. These weightings are: Steel, 37.50 per cent; cement, 7.14 per cent; lumber, 17.10 per cent; labor, 38 per cent. The weightings were determined by studying the annual production of the three prime materials and the number of common laborers (exclusive of farm labor) in the United States. The markets considered are structural steel in Pittsburgh, cement without bags, f.o.b. Chicago; 3x12-in. to 12x12-in. Southern pine to contractors in New York, and the average price of common labor in the twenty cities listed in *Engineering News-Record* in the first issue of each month. The prices are those obtaining in the last week of each month and published in the first issue of each month. The quantities of these materials and the number of man-hours used in computing the Index Number were selected so that the total cost (quantities multiplied by prices, and added together) for 1913 would be $100 for a "unit of construction."

The accompanying tabulation gives the *Engineering News-Record* Construction Cost Index Number for every month from 1913 to December, 1924, while the chart gives both the monthly and yearly numbers. During the last twelve years the index number has averaged 171. The 1924 average was 215, against 214 in 1923. At the clost of 1924, however, the number was 4 per cent lower than it was one year before.



Engineering News-Record Construction Cost Index Number—1914 to 1924

	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924
January	89.22	87.12	130.46	167.75	184.51	198.05	206.55	230.87	168.72	191.70	217.90
February	89.22	87.36	134.46	167.75	184.51	201.50	225.10	230.67	168.72	197.40	220.30
March	88.97	87.66	142.96	175.66	184.51	198.05	240.85	224.27	162.04	205.25	224.60
April	87.97	90.16	147.31	183.41	186.01	191.25	265.20	213.07	164.72	213.50	221.60
May	88.62	90.16	148.86	187.61	186.01	191.25	268.90	210.82	164.62	216.70	222.38
June	87.87	88.96	146.51	199.26	186.31	191.85	273.80	209.82	166.62	220.70	216.85
July	88.12	90.51	145.76	204.01	188.65	193.65	265.65	203.82	169.70	222.10	214.40
August	90.14	91.76	146.56	198.41	193.85	196.65	252.00	193.07	173.40	221.50	213.15
September	90.36	93.01	149.56	190.31	193.85	202.85	255.20	188.27	185.00	221.50	211.25
October	88.51	96.16	152.91	167.11	193.85	202.25	255.20	182.57	188.60	220.30	207.55
November	87.26	101.06	155.66	166.51	193.55	206.85	255.32	166.32	188.60	220.90	205.70
December	86.51	107.06	167.15	167.11	194.75	206.85	251.62	167.82	192.60	217.30	208.58
Averages	88.56	92.58	147.35	181.24	189.20	198.42	251.28	201.78	174.45	214.07	215.36

Spring Prices of Materials 1913 to 1924

E.N.-R. Statistics

PRICES of construction materials in effect during the months of April, May and June of each year, beginning with 1913 have been published annually in *Engineering News-Record* since 1919.

The accompanying tabulations are the same as last year's, with the addition of the spring prices for 1924, the general average for the twelve-year period and the quotations as of Dec. 18, 1924.

Each December since the depression of 1921 has shown a steady increase in the net gain of price advances over declines, as compared with the general average, with the exception of the year just closed. The excess of advances over declines was considerably smaller in December, 1924, than during the corresponding period of 1923.

Prices of basic construction materials started to decline in May, 1924, and followed a consistent downward trend until after election, at which time they turned in the opposite direction. Prices of general commodities, those not specially related to construction, started to show firmness several months before the rise in building materials occurred.

With the trend still upward it is estimated that any rise occurring in the first quarter of 1925 will have to be unusually abrupt in order to pass the point reached in the spring of either of the two preceding years. Since 1923 and 1924 were the two heaviest building years in history, prices as of the spring of 1925 will probably not reach levels prohibitive to the continued expansion of the construction industry.

While steel is developing firmness in the current market, the prices of such items as beams, bars and sheetpiling, as of Dec. 18, are under the general average for the spring months since 1913. Practically all the other basic materials are above the general average for the twelve years.

Engineering News-Record Comparison of Spring Construction Materials Prices Since 1913

(All Prices F.O.B. New York Except Otherwise Stated)

	Portland Cement, per bbl. *net, without bag*, f.o.b. Chicago	Southern Pine, 3x12 to 12x12, 20 Ft. and Under	Common Brick (per M.)	Crushed Stone (per Cu. Yd., 1½ In.)	Sand (per Cu. Yd.)	Gravel (per Cu. Yd., 1-in.)	C.-I. Pipe (6-In. per Ton)	Beams and Channels (3-15-In. per 100 lb.)	Beams, Etc. Pittsburgh Mill	Reinforcing Bars, 4-In. and Larger Pittsburgh Mill	Reinforcing Bars, ½-In. and Larger	Steel Sheetpiling, Pittsburgh Mill	Tank Plates, ¼-In. and heavier per 100 Lb.	Hollow Tile (10x12x12 per Block), Factory, Perth Amboy N. J.	Linseed Oil (Raw in Barrels)	Freight to Pittsburgh on 100 Lb.	Pittsburgh Steel (per Lb.)	Average Common Labor per Hr. for U.S.
April, 1913	$1.19	$28.50	$7.00	$0.90	$0.50	$0.85	$24.00	$2.15	$1.70	$1.50	$2.25	$1.60	$1.61	$0.102	$0.48	$0.16		$0.17
May, 1913	1.19	28.50	7.00	.90	.50	.85	23.50	2.15	1.65	1.50	2.25	1.60	1.61	.102	.50	.16		.17
June, 1913	1.19	28.50	7.00	.90	.50	.85	23.00	2.15	1.50	1.50	2.25	1.60	1.61	.102	.48	.16		.17
Average	$1.19	$28.50	$7.00	$0.90	$0.50	$0.85	$23.50	$2.15	$1.62	$1.50	$2.25	$1.60	$1.61	$0.102	$0.49	$0.16		$0.17
April, 1914	$1.12	$28.50	$5.50	$0.95	$0.50	$0.90	$22.00	$1.95	$1.15	$1.20	$2.25	$1.60	$1.31	$0.102	$0.54	$0.16		$0.18
May, 1914	1.12	30.00	5.50	.95	.50	.90	22.00	1.85	1.15	1.15	2.25	1.60	1.31	.102	.54	.16		.18
June, 1914	1.12	30.00	5.60	.95	.50	.90	20.50	1.85	1.10	1.15	2.25	1.60	1.31	.102	.53	.16		.18
Average	$1.12	$29.50	$5.55	$0.95	$0.50	$0.90	$21.50	$1.85	$1.13	$1.17	$2.25	$1.60	$1.31	$0.102	$0.54	$0.16		$0.18
April, 1915	$1.11	$28.50	$5.50	$0.90	.....	$0.85	$20.00	$1.90	$1.15	$1.15	$1.95	$1.60	$1.36	.....	.....	$0.169		$0.18
May, 1915	1.11	28.50	5.75	1.05	.....	.85	20.50	1.90	1.20	1.15	2.00	1.50	1.32	.....	.....	.169		.18
June, 1915	1.15	26.50	6.00	1.05	.....	.85	22.00	1.90	1.20	1.20	2.00	1.50	1.37	.....	.....	.169		.18
Average	$1.12	$27.75	$5.75	$1.00	.....	$0.85	$20.75	$1.90	$1.18	$1.17	$1.97	$1.53	$1.35	.....	.....	$0.169		$0.18
April, 1916	$1.42	$31.50	$8.50	$0.95	$0.40	$0.80	$30.50	$2.50	$2.50	$2.45	$3.10	$2.50	$2.50	.....	$0.81	$0.169		$0.18
May, 1916	1.46	31.50	7.25	.95	.40	.85	30.50	2.50	2.75	2.50	3.25	2.50	2.65	.....	.81	.169		.18
June, 1916	1.46	30.50	8.00	.95	.50	1.00	30.50	2.60	2.75	2.50	3.10	2.50	2.75	$0.085	.73	.169		.18
Average	$1.45	$31.00	$7.90	$0.95	$0.45	$0.90	$30.50	$2.55	$2.67	$2.47	$3.15	$2.50	$2.65	$0.085	$0.78	$0.169		$0.18
April, 1917	$1.76	$32.75	$9.50	$1.20	$0.50	$1.25	$47.50	$3.75	$3.88	$3.35	$4.60	$3.60	$5.00	$0.157	$1.04	$0.169		$0.28
May, 1917	1.90	34.75	11.50	1.25	.50	1.35	55.50	3.80	4.00	3.50	.....	3.60	5.50	.157	1.21	.169		.28
June, 1917	1.91	39.75	10.25	1.25	.50	1.25	55.50	5.00	4.31	3.50	5.10	3.60	7.00	.157	1.31	.169		.28
Average	$1.86	$35.75	$10.40	$1.25	$0.50	$1.30	$51.70	$4.15	$4.06	$3.45	$4.85	$3.60	$5.80	$0.157	$1.19	$0.169		$0.28
April, 1918	$1.96	$42.75	$10.25	$1.75	$1.25	$2.00	$55.35	$4.20	$3.00	$2.90	$4.09½	$3.10	$4.45	$0.16	$1.55	$0.195		$0.37
May, 1918	1.96	42.75	10.00	1.75	1.25	2.00	55.35	4.20	3.00	2.90	4.09½	4.00	4.45	.16	1.55	.195		.37
June, 1918	2.00	43.25	10.25	1.75	1.25	2.00	61.35	4.20	3.00	2.90	4.09½	4.00	4.45	.17	1.58	.195		.37
Average	$1.97	$43.00	$10.15	$1.75	$1.25	$2.00	$57.35	$4.20	$3.00	$2.90	$4.09½	$3.70	$4.45	$0.16	$1.56	$0.195		$0.37
April, 1919	$2.00	$45.00	$15.00	$1.75	$1.25	$2.00	$57.70	$3.47	$2.45	$2.35	$3.37	$2.55	$3.67	$0.1944	$1.55	$0.27		$0.46
May, 1919	2.00	45.00	15.00	1.75	1.25	2.00	57.70	3.47	2.45	2.35	3.37	2.55	3.67	.1944	1.63	.27		.45
June, 1919	2.00	46.00	15.00	1.75	1.25	2.00	52.70	3.47	2.45	2.35	3.37	2.55	3.67	.1944	1.76	.27		.45
Average	$2.00	$45.50	$15.00	$1.75	$1.25	$2.00	$56.03	$3.47	$2.45	$2.35	$3.37	$2.55	$3.67	$0.1944	$1.65	$0.27		$0.45
April, 1920	$2.00	$72.00	$18.00	$2.00	$1.25	$2.25	$72.30	$5.00	$4.00	$4.00	$5.00	$3.65	$5.00	$0.3411	$1.87	$0.27		$0.55
May, 1920	2.08	70.00	18.00	2.15	1.50	2.50	76.30	5.00	4.00	4.00	5.00	3.65	5.00	.3411	1.87	.27		.57
June, 1920	2.15	70.00	18.00	2.15	1.50	3.00	76.30	4.47	4.00	3.75	5.00	3.65	4.67	.....	1.73	.27		.58
Average	$2.08	$70.50	$18.00	$2.10	$1.42	$2.58	$74.97	$4.83	$4.00	$3.92	$5.00	$3.65	$4.89	$0.3411	$1.83	$0.27		$0.57
April, 1921	$2.17	$48.00	$16.00	$1.95	$1.25	$2.50	$63.30	$3.33	$2.00	$2.00	$3.28	$2.55	$2.00	.....	$0.73	$0.38		$0.56
May, 1921	2.17	48.00	15.00	1.95	1.25	2.50	63.30	3.33	2.20	2.10	3.38	2.55	2.40	.....	.67	.38		.57
June, 1921	2.17	43.00	14.50	1.95	1.25	2.50	58.30	3.33	2.20	2.10	3.38	2.55	2.40	$0.1541	.80	.38		.58
Average	$2.17	$46.25	$15.00	$1.95	$1.25	$2.50	$61.60	$3.33	$2.15	$2.10	$3.35	$2.55	$2.25	$0.1541	$0.73	$0.38		$0.57
April, 1922	$1.97	$44.00	$16.25	$1.75	$1.00	$1.75	$47.30	$2.48	$1.50	$1.50	$2.58	$1.75	$2.48	$0.1789	$0.83	$0.38		$0.43
May, 1922	1.97	43.00	17.00	1.75	1.00	1.75	47.30	2.58	1.60	1.60	2.68	2.00	2.58	.1789	.91	.38		.42
June, 1922	1.97	43.00	20.00	1.75	1.00	1.75	49.30	2.58	1.60	1.60	2.68	2.00	2.58	.1789	.91	.38		.43
Average	$1.97	$43.33	$17.75	$1.75	$1.00	$1.75	$47.97	$2.55	$1.57	$1.57	$2.65	$1.92	$2.55	$0.1789	$0.88	$0.38		$0.43
April, 1923	$2.20	$58.00	$20.00	$1.75	$1.00	$2.25	$57.50	$3.44	$2.45	$2.35	$3.34	$2.50	$3.44	$0.2362	$1.13	$0.34		$0.50
May, 1923	2.20	60.00	20.00	1.75	1.25	2.25	58.50	3.44	2.50	2.40	3.34	2.60	3.44	.2691	1.16	.34		.51
June, 1923	2.20	60.00	20.00	1.75	1.25	2.25	63.00	3.64	2.50	2.40	3.54	2.65	3.64	.2691	1.16	.34		.53
Average	$2.20	$59.33	$20.00	$1.75	$1.16	$2.25	$59.66	$3.50	$2.48	$2.38	$3.40	$2.58	$3.50	$0.2581	$1.15	$0.34		$0.51
April, 1924	$2.20	$59.00	$20.00	$1.85	$1.25	$2.00	$62.60	$3.64	$2.45	$2.40	$3.54	$2.65	$3.64	$0.2442	$0.95	$0.34		$0.54
May, 1924	2.20	58.00	20.00	1.85	1.25	1.75	62.60	3.59	2.38	2.33	3.49	2.45	3.59	.2786	.95	.34		.56
June, 1924	2.20	54.00	20.00	1.85	1.00	1.75	62.60	3.59	2.28	2.25	3.49	2.38	3.59	.2786	.98	.34		.56
Average	$2.20	$57.00	$20.00	$1.85	$1.16	$1.83	$62.60	$3.60	$2.37	$2.32	$3.50	$2.49	$3.60	$0.2671	$0.96	$0.34		$0.55
General average	$1.77	$43.11	$12.65	$1.49	$0.95	$1.63	$47.33	$3.17	$2.38	$2.27	$3.31	$2.51	$3.13	$0.1810	$1.07	$0.24		$0.36
Dec. 18, 1924	$2.20	$53.00	$15.00	$1.85	$1.00	$2.00	$56.10	$3.34	$2.05	$2.10	$3.24	$2.00	$3.34	$0.2388	$1.14	$0.34		$0.561

of Cost and Volume

Comparing the spring of 1924 with that of the preceding year, the advances in this tabulation are found to be mainly in such items as cast-iron pipe, crushed stone, hollow tile and common labor. Declines, however, are shown for steel, pine lumber, gravel and linseed oil.

Quotations as of Dec. 18, 1924, were slightly under those of the corresponding period last year in nearly all the items included in this tabulation with the exception of pine timbers, crushed stone, hollow tile, linseed oil and common labor.

The present trend, however, is decidedly upward in steel, lumber, brick, concrete aggregates, linseed oil, red and white lead and the non-ferrous metal products.

Mid-December Price Situation (1922-3-4) In Relation To Spring Averages—Advances In Excess Of Declines
(+ indicates increase; — indicates decrease)

Materials	Per Cent Change — Dec. 14, 1922 from Average Spring 1913–22	Dec. 13, 1923 from Average Spring 1913–23	Dec. 18, 1924 from Average Spring 1913–24
Crushed stone, New York	+22	+20	+24
Sand, New York	+23	+34	+ 5
Gravel, New York	+28	+23	+23
Cast iron pipe, New York	+22	+34	+19
Structural shapes, New York	+ 1	+16	+ 5
Tank plates, New York	+ 3	+18	+ 7
Linseed Oil, New York	— 7	—12	+ 7
Freight Pittsburgh to New York or Chicago on finished steel products	+48	+41	+41
Steel sheet piling, Pittsburgh mill	+16	+ 5	—20
Structural shapes, Pittsburgh mill	—16	+ 4	—14
Reinforcing bars, Pittsburgh mill	—12	+ 6	— 7
Reinforcing bars, New York warehse	+26	+ 7	— 2
Average	+13	+16	+ 7

Outlook for Materials Prices in 1925

PRICES of most of the basic materials are slightly below last year's levels. Only during the last two months have there been any trustworthy indications as to the probable trend of prices in 1925. It now appears that the winter will develop an active building program, followed by a decidedly brisk demand for construction in the spring. Prices will undoubtedly rise during the next three months.

Pig Iron—Higher fuel and labor costs together with active demand are forcing the price of pig iron upward from week to week. The present market, however, is still about $2 per ton under that of a year ago. Scrap prices are a trifle higher than at this time last year.

Railway Supplies—While there has been no change in the mill base of standard rails in more than a year, light rails, ties and track supplies are considerably under the price levels of Jan. 1, 1924. Since the removal of election uncertainties, railroad buying has been really active, with a consequent upward turn in prices.

Pipe—Cast-iron pipe, clay drain tile and sewer pipe are all cheaper than a year ago. Wrought-steel pipe has shown little or no price reaction during that time at mills or warehouses. At present the market is seasonally dull. With public utilities one of the few industries to show profit from business operations during 1924, and recent steady gains recorded in lettings for public work, the price trend in these materials will probably be upward during the first quarter of 1925.

Road and Paving Materials—Most of these are slightly below a year ago so far as prices are concerned. And this, with a gain of 14 per cent in paving contracts let during 1924 as compared with the previous year. This gain has been in evidence since 1922 and indications are that 1925 will pile up a heavier volume of road work than any other year ever did.

Concrete Aggregates—Sand, gravel and crushed stone prices are all higher than a year ago. The trend is up because of unfavorable weather and the expected heavy spring demand.

Lime and Cement—Both of these materials are substantially under prices in effect a year ago. Lime is fairly stable. Cement, however, was reduced about 10c. per bbl. two weeks ago in ten important centers of the West. This literally amounts to a price reduction in the presence of a growing demand for winter construction.

Brick and Hollow Tile—Agreeing with the trend in clay products, brick and tile prices are slightly lower than a year ago. Following the winter consumption of these materials, a brisk spring demand is expected to result in higher prices before June, 1925.

Structural Steel—Not only the principal heavy rolled products, such as bars, shapes and plates, are on the upgrade, but all steel products have experienced growing price firmness since Dec. 1, 1924. Reinforcing bars and shapes are $2.10 per 100 lb. at Pittsburgh mills, against $2.40@$2.50 per 100 lb. one year ago. The price trend will continue upward until stocks have been replenished or buyers are covered against a further rise in prices.

Lumber—Prices are below those of January, 1924, but the outlook has cleared in the last three months. Demand revived in all items last month. The few price advances are in the Northern states where low temperatures might ordinarily be expected to discourage winter building.

Paint Materials—The recent peak prices in the non-ferrous metals market have resulted directly in higher red and white lead quotations. Linseed oil has made an average gain of about 6c. per gal. in thirty days. Lead is 1¼c. per lb. above a year ago and linseed oil, 22c. per gal. higher than on Jan. 1, 1924.

Other Materials—Structural rivets are about 50c. per 100 lb. higher than a month ago but still lack 15c. of touching the January, 1924 level. Wire nails have risen 10c. per keg in thirty days and threaten to continue in this direction, in keeping with most of the other wire products. Roofing materials are higher. The rising tendency in steel sheets is more pronounced in the galvanized than in black or blue annealed. Steel sheetpiling is considerably under a year ago and the price is steady. Rope quotations are tending higher, particularly along the Atlantic seaboard. Prices of explosives and water and sewage treatment chemicals show few fluctuations.

Labor Outlook for 1925

THE year starts off with labor divided into two distinct groups. The first and more powerful consists of the highly organized trades employed in transportation, mining and construction. In this group the wage trend is decidedly upward, owing to the strength of the unions involved, the urgent demand for the services of the mechanics and the scarcity of apprentices.

In the second group the wage trend is downward. This group is headed by the shop and factory workers and includes all unorganized workers down to common laborers.

In about 70 per cent of the principal industrial centers the 1924 wage scales will remain in force throughout the current year. In the others, wage demands will probably result in higher schedules. The carpenters' unions throughout the country are organizing a drive for a five-day week with pay for the full 5½ days. Up to the present time the proposition has not been seriously considered by the building trades employers.

During the year common labor in twenty centers of the United States averaged 55½c. per hour. The average at the beginning of 1924 was 54c., compared with 55½c. at present. The trend is down owing to seasonal unemployment in the Northwest and Southwest. During the seven months period, May to November, 1924, the average rate remained at 56c. per hour.

With few exceptions the principal cities of the United States look forward to an active construction season surpassing, it is expected in many instances, the record year 1924.

The outlook for work in twenty important centers of the country is given by *Engineering News-Record* as follows:

Atlanta—Building is slow in Atlanta proper because of the overbuilt condition of the city. In the outlying sections, however, there is considerable activity. There are no strikes pending, and no inclination on the part of building labor to demand higher rates. Some unemployment is reported, but this is being rapidly absorbed by nearby cities where construction is more active.

Baltimore—The 1925 program amounts to about $100,000,000 in new buildings, roads, sewers and other municipal work. All authorities agree that the coming year will break all previous records. Labor seems to be well satisfied regarding wages and there are no strikes or disputes slated for the coming year. There were a number of disputes last year, but these were due to letting of contracts to non-union sheet metal and steel fabricating companies by some of the general contractors.

Birmingham—Present indications are that 1925 will be the greatest building year Birmingham, Ala., has ever known. At present there are nine large skyscrapers under construction in the downtown section, representing a total of 93 stories and a total cost of over $5,000,000. Completion is not expected on these jobs before early summer. During January, work will start on an addition to a department store to cost $1,250,000; Jefferson County will erect a $1,500,000 courthouse; the city will build a $500,000 library, and concrete viaducts over railroad tracks are proposed. There are no strikes in prospect. It is thought that labor will not demand higher wages this year. There are few unskilled laborers unemployed and plenty of work is available for skilled mechanics.

Boston—There are strong indications that the coming season will be the best known for many years past. Architects look for an unusually large amount of private work. State highway and municipal improvements will without doubt occupy much of New England's construction program for the coming summer. The unemployment situation at present is decidedly pronounced, particularly in the case of unskilled common laborers. This condition, however, is expected to disappear in the spring, at which time wage demands for a base rate of $1.25 per hour will probably appear.

Chicago—Construction is more active than a year ago and to all appearances 1925 will be the bigger year. Plans are already drawn for about $200,000,000 worth of construction, not including small apartments, factories, etc. The present labor situation is quiet, although talk of proposed wage demands for a base pay of $1.50 per hr. for all trades is frequently heard in labor circles.

Cleveland—At no time in the development of Cleveland and vicinity has the outlook for the construction industry been better. The year 1923 was the biggest in point of appropriations, totalling approximately $106,000,000. During 1924 a slowing down was recorded; approximately $100,000,000 in building projects having developed up to Dec. 1.

Actual plans have been made to take care of $53,000,000 worth of construction for the next six months. There is no surplus of any kind of labor and there is actual shortage on many crafts.

About the only evidence of uncertainty is supplied by demands of painters and plasterers for a five-day week, the first demand of its kind, even though long heralded, to be offered in the building trades. Negotiations already are under way, but it will be weeks, perhaps months, before any settlement can be reached. In lieu of the five-day week, the members of these two crafts are demanding that they receive the equivalent in wages.

Between now and March 1 ten other crafts will ask for wage readjustments. It is expected they will ask for more money. Consideration is called to the fact that the cost of living in Cleveland is held to be higher than in any other American city.

The following crafts are planning their wage readjustment campaign, to be considered by employing factions about March 1: Electricians, elevator constructors, fixture workers, glaziers, iron workers, plumbers, roofers, sheet metal workers, steam fitters, stone cutters.

All other crafts are working and will continue to work for another four years upon the five-year agreement basis reached last season.

Cincinnati—Building construction is on the increase and looks favorable for 1925. There are no strikes or wage disputes pending. Building trades mechanics have demanded higher rates for the coming season and these increases have been authorized by the Associated Building Industries. There is very little unemployment.

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Dallas—A building boom for 1925 surpassing that of the 1918-21 period is expected in the Dallas district, owing to bumper crops in west Texas and new oil developments in the northern part of the state. No strikes or other labor troubles are in sight, although a slight surplus of common laborers is evident owing to the recent influx of men from the cotton fields. No dissatisfaction with existing wage schedules is expressed, as it is estimated that about 40 per cent of all construction work is done on the open shop basis.

Denver—The outlook for next year is exceptionally good. Lumber dealers predict that 1925 will be the largest in the history of the city and state.

There are no strikes or wage disputes. No requests for approval of increases in wages have so far been filed with the state industrial commission and the only increase in prospect will be sought by the bricklayers who have not yet formulated and submitted their demands.

Employment is fairly good. About 80 per cent of the bricklayers and carpenters are employed and 60 per cent of structural iron workers. Common labor is especially plentiful and there is a considerable surplus due to workers floating in from the beet and oil fields.

Detroit—A good year is forecast for 1925, basing estimates on work in the proposed stage. Apartments lead, with a fair amount of business buildings, mostly public and industrial. No strikes are reported in the Detroit section and there are no definite indications that building trades mechanics will demand higher rates for next season. There is some unemployment among common laborers and an increase in the number of men available for building work, owing to recent depression in the local manufacturing industries.

Los Angeles—Many big highway and flood control projects are planned this year. A recent survey shows that a housing shortage still exists. Wage demands are out of the question at present owing to the influx of all kinds of laborers from the colder sections of the country. In fact, there is a tendency to attempt reduction of the local building trades wage schedule because of the surplus of mechanics.

Minneapolis—Architects, engineers, supply dealers and building trades mechanics are all looking for a good year in 1925 for this field; better than 1924 proved to be. There is a seasonal lull in construction at this time. Architects' offices are reported all busy and there are said to be no unemployed draftsmen in the Twin Cities. There is some unemployment in the building trades, but only normal for the season. It is not expected that building trades mechanics will demand higher rates for next season. No wage disputes and no strikes exist in this locality. The Northwest is particularly behind in school building construction and contemplated work for next year includes many educational structures of considerable size.

New Orleans—Numerous large projects are included in the 1925 building program. It is unlikely that building trades mechanics will demand higher wages for the coming season. Structural iron workers, under an agreement effected in June, have had their rate increased 12½c. per hour, making the present base $1.12½ per hour, effective Dec. 1, 1924. The regular seasonal unemployment among the migratory types of laborers has been in evidence since extremely low temperatures began to affect the Northern areas.

New York—The next two months will probably see an unusual rush of plan filing and contract letting in this district. Plenty of building materials are available, and an abrupt rise in prices is not feared by the prospective builder. The main point of interest is the fact that the present building trades wage schedule expires Dec. 31, 1925 and for that reason most of the contract-letting will fall in the first half of 1925 in order to take advantage of the lower materials' prices and the stabilized wage rates now prevailing. According to the Bureau of Buildings fewer structures were erected in 1924 and at a greater cost than during the preceding year.

Philadelphia—Public work is expected to be particularly active. Other classes of construction will probably equal last year in volume. There is a consistent gain in issuance of building permits and it is not thought that building trades wage rates will be any higher than last year.

Pittsburgh—Numerous steel and other industrial plants are running full time. Several large construction projects are booked and architects are advertising for additional draftsmen. No strikes or wage disputes pend and no changes in the present wage schedules are looked for.

St. Louis—The present wage agreement expires about April 1, 1925, but no trouble is expected. Carpenters are taking national referendum on the five-day week. Much large building work is in prospect; materials prices are stable and there is every indication of a record construction year for city and vicinity.

The master builders are organized today and in recent controversies with building crafts have won through on major points.

The present indications are that building laborers will be willing to renew present contracts. There is some seasonal unemployment but generally speaking there has been a decrease in unemployment in the last sixty days.

San Francisco—The 1925 construction outlook is favorable from all angles. There are no wage disputes in the building trades and none looked for.

Seattle—The year 1925 will probably exceed the exceptionally active building program of 1924. Sheet metal workers are on strike for an increase of 50c. per day, making the base pay $9; non-union men are manning the jobs. The carpenters' union voted for a five-day week with five and one-half days pay but have not yet negotiated with the master builders for its inauguration. No other crafts have announced intentions of asking for increases or changes in working conditions. There is some unemployment, particularly among common laborers, usual at this time of the year.

Montreal—Construction is slowing down. Many tenders recently called were found to be too high. The projects for 1925 include two hotels of more than $1,500,000 each and three large office structures. Factory construction does not look bright and many disused factories are on the market with no bidders.

No unsettled strikes and no prospects of strikes exist in any of the building trades. Building trade mechanics will probably receive lower wages when present "masters' agreements" expire. Considerable unemployment is noted—40,000 unemployed in the Montreal district, of whom 15,000 are usually engaged in construction.

Railway and Marine Terminals: 1924 Projects

Large new passenger stations are few but costly—Extensive developments and projects in freight stations and yards—Increased water-front facilities at large ports

IMPROVEMENTS in yards and terminals constitute a prominent item in the extensive improvements which the railways have now under way or planned for early construction, and the wide extent and comprehensive character of these terminal works are indicated by the following review. A special line of such activities is the provision of greatly increased facilities at ports, both for the handling of ordinary business and for the intensive handling of coal and ore in bulk. Passenger terminal improvements, which are included also, are relatively few but involve great expenditures.

In this review of railway terminal and allied improvements only some of the larger works and projects are noted, but thousands of kindred but minor works, especially for freight facilities, swell the total expenditures to an immense sum and will aid materially in securing increased efficiency and economy in the handling of the railway transportation business.

Passenger Stations and Terminals

New Stations—Four great passenger terminals representing together nearly $200,000,000, are the new union stations at St. Paul, Chicago and Cleveland and the new Philadelphia station for the Pennsylvania R.R. The St. Paul station, costing about $15,000,000, was opened in December, 1924. The Chicago station, to be completed in April, 1925, is distinctive in its arrangement as a double-end stub terminal, with its concourse between the ends of two groups of tracks. Its direct cost is estimated at $66,000,000, but with three large freight terminals and a railway mail terminal made necessary by its construction the cost of terminal improvements in its vicinity will be about $106,000,000. The Cleveland union station is in the early stages of construction while the Philadelphia station is only in the planning stage; the cost of the latter has been estimated unofficially at $60,000,000. The Camden terminal for the seashore lines of the Reading R.R., opened in 1924, and costing $3,500,000, requires relatively simple accommodations, since most of its passengers transfer to and from Philadelphia by ferry.

Among smaller important developments the following may be noted: Union stations are being built at Springfield, Mass., by the Boston & Albany R.R. and at Bethlehem, Pa., for the Lehigh Valley R.R. and Reading R.R. ($700,000). The Pennsylvania R.R. in 1924 built a station at Trenton, costing $1,250,000, and will build others at Lancaster ($1,000,000) and Altoona ($1,750,000). The Chesapeake & Ohio is building a station and track layout at Ashland, Ky., to cost $409,300, and the Illinois Central is completing a passenger terminal at Baton Rouge, La., costing $758,000.

The old single-span steel trainshed of the union station at Duluth was taken down in 1924 and replaced with platform shelters. A $300,000 union station at Ogden was opened in 1924, replacing one destroyed by fire, and at Boise, Idaho, a $230,000 station is being built by the Union Pacific in connection with the new loop which puts that city on a through line. Plans have been prepared for a station at Houston, Texas, accommodating several Southern Pacific lines.

Projects—Among projects for passenger terminals, Chicago leads with a curiously complicated problem. It has two modern stations and a third authorized, this last on a very large scale. Three old stations, each used by a group of railroads, need reconstruction and in each case the owners have plans for a new station capable of accommodating the three groups, while the Illinois Central proposes that all these roads come into its authorized lake-front terminal. It seems probable, however, that one additional station will be built, making four in all to serve a score of railroads. At Cleveland, a new station will be required for the Pennsylvania R.R., which has declined to use the new union station and is still using an old lake-front station, but no site has been selected or plan adopted.

Two important projects in the New York terminal district affect the railroads approaching from the west. The Pennsylvania R.R. proposes to build a large station near Newark, where passengers would change for the New York tube lines and where the electric locomotives would take on the trains, the present Manhattan Transfer being abandoned. A larger but quite indefinite project is for a great union station on the Jersey meadows with tube line connections, this being for all west-side lines with only ferry service to New York.

Buffalo is continuing its protracted negotiations for improvement and perhaps relocation of the old union station used by the New York Central R.R. and the Pennsylvania R.R. Projects for a modern union station at Cincinnati have been put forward at intervals for several years and a plan now in the promotional stage is to include both passenger and freight facilities. On a smaller scale is the proposed union station at Flint, Mich., to serve the intersecting lines of the Pere Marquette and Grand Trunk railroads. With two adjacent stations at Omaha, one of which is a union station, frequent efforts have been made to secure one union station for all roads; this project was revived in 1924, but fell through again. Both Lincoln, Neb., and Des Moines, Iowa, have dreams of new union stations. However, at Des Moines, the city council has included a union station in its program of community needs and the matter is under consideration in connection with a suggested city planning scheme. From Portland, Ore., there is reported a project for a new union station and revision of terminal facilities.

Freight Stations and Terminals

Progress in freight terminal facilities has been widespread and promises to continue, both in cities and at the large outlying yards for the classification, interchange and forwarding of freight. At division points these yard improvements frequently include engine terminals. In new city terminals, a noticeable feature is the increasing number of double-deck freight stations. This arrangement, which presents some advantages in utilization of a given area and disadvan-

tages in additional handling of freight, has been enforced usually by the requirements of grade separation. The tracks may be above the streets, as at Detroit and Indianapolis, or below them, as at Chicago and Dallas. For intensive use of high-value property in city terminals, double-deck stations with tracks on two levels have been proposed and designed, but no station of this type has yet been built in this country.

In Chicago, terminal improvements are progressing on a large scale. Besides the new combination freighthouses and warehouses of the Pennsylvania R.R. and Chicago & Alton R.R., the Chicago, Burlington & Quincy R.R. in 1924 completed its double-deck freight station with inbound and outbound houses separated at the upper or street level by a 60-ft. driveway. These buildings, three stories high, are planned for additional stories, with connecting bridges at each floor. Progress has been made by the Illinois Central R.R. with the vast amount of filling for its Markham terminal yard (now 55 per cent completed), while the Chicago & Western Indiana R.R. has completed material extensions to its great interchange yard at Clearing. An interesting project is for the establishment of a large outlying railway terminal and market for the fruit, vegetable and poultry business, since city improvements are wiping out the group of old and unsanitary markets.

Next to Chicago in recent activities ranks Dallas, Texas, with its new $5,000,000 Santa Fé terminal comprising lofty warehouses and office building of reinforced-concrete, with a freighthouse occuping the basements (see *Engineering News-Record*, Dec. 11, 1924, p. 942). In addition, the Missouri-Kansas-Texas Lines have completed at Dallas a $500,000 seven-story warehouse of reinforced concrete, while additional freight stations, warehouses and other terminal facilities are reported as planned by the Texas & Pacific, the Southern Pacific and the Rock Island railroads. Furthermore, by the construction of nine miles of line at a cost of $827,500 the Southern Pacific Ry. is completing a belt line with interchange yards for all the railroads.

In the East—For the industrial district of New York and vicinity, comprehensive improvements are badly needed, but these have not got beyond the paper stage. Two outstanding projects are the improvement of the West Side terminals of the New York Central R.R. in connection with grade separation, and the handling of freight between the city and the various railroad yards on the Jersey side of the Hudson River in order to eliminate the slow and costly ferry transfer and teaming. Unfortunately, these projects have not only to pass further stages of technical study but also to overcome serious political obstacles before they reach a constructive stage. Meanwhile, the Pennsylvania R.R. is spending $1,000,000 on car ferry facilities, a new yard and other improvements for its New York harbor terminal at Greenville, N. J., and has appropriated $1,000,000 towards the proposed Meadows yard near Newark. Alterations to freight terminals in the Black Rock district at Buffalo will be necessitated by an extensive grade separation project.

Turning "down east," the Portland Terminal Ry. has constructed extensive freight yards and a large engine terminal at Rigby, a suburb of Portland, Me., in order to eliminate the congestion at the old city yards, and has modernized its freighthouse to permit motor truck operation. The New York, New Haven & Hartford R.R. in 1924 enlarged its Cedar Hill (New Haven) gravity yard at a cost of $369,000; it also completed a new hump yard at Worcester and has plans for construction and reconstruction of classification yards aggregating $500,000. The Boston & Albany R.R. has completed extensive improvements to its freight station and yards at Springfield, Mass. The Reading R.R. has completed engine terminals at Raritan and Rutherford, N. J., costing $620,000 and $440,000, and has plans for a $207,500 freight station at Lebanon, Pa.

There is considerable activity around Toledo, Ohio. The Pennsylvania R.R. is improving its outer yard (50 per cent completed) and engine terminal (15 per cent) at a combined cost of $991,500; it has also relaid its Water St. tracks with 159-lb. girder rails and granite block paving at a cost of $193,000. The Michigan Central R.R. and Pere Marquette R.R. have each spent about $2,000,000 on new terminal yards, while the Toledo Terminal Ry. is spending $375,000 on track and yard improvements. At Detroit, there is the new freight yard and engine terminal of the Pennsylvania-Detroit R.R., $1,286,000 (for joint use with the Wabash and Pere Marquette roads); also its double-deck city freight station (*Engineering News-Record*, June 29, 1924, p. 1082, and Aug. 7, p. 227).

New freight terminal facilities at Cleveland are included in the union station plans. At Indianapolis, the latest item of the extensive freight terminal reconstruction necessitated by track elevation is the $500,000 double-deck freight station and team yard of the Monon Line. The Big Four R.R. in 1924 completed its eastbound yard and engine terminal at Sharonsville, $275,000, while work proposed includes $230,000 for engine terminal improvements at Kankakee and $100,000 for freighthouses at Galion and Bellefontaine.

Many improvements are planned in the terminals of the numerous railroads centering at East St. Louis, Ill.; the Baltimore & Ohio has started a large yard; the Big Four and the Burlington propose similar yards, and the Illinois Central is completing yard enlargements at a cost of $897,000. Plans are reported for freighthouses at Omaha, Neb., for the Missouri Pacific R.R. and the Rock Island Lines, while across the river at Council Bluffs, the Illinois Central has spent $414,000 on yard and engine terminal improvements.

In the South—This same road has spent $1,066,000 on its yards at Mounds, Ill., a freight station at Memphis and freight facilities at Baton Rouge, besides other work at New Orleans. The Louisville & Nashville had $600,000 authorized in 1924 for a yard at Gentilly, La., and $793,000 for other terminal improvements, including a large warehouse at New Orleans. At this place also the Public Belt Ry. has built an engine terminal costing $255,000. Three large yards for the Florida East Coast Ry. at South Jacksonville, Fort Pierce and Miami will cost $3,000,000, while seven miles of its Miami belt line have been built at a cost of $230,000. The Seaboard Air Line has completed a brick freight station with team yard at Orlando, Fla. ($140,000), and the Central of Georgia is spending $630,000 on improvements at Columbus, Ga. The Chesapeake & Ohio has completed yard improvements for $1,475,000 and new work will cost $4,300.000.

Extensive facilities are planned at Kansas City, including industrial development along nine miles of new line to complete a belt railroad for the Kansas &

Missouri Railway Terminal Co. (acquired by the Kansas City Southern Ry.). Similar development is to be made by the Union Pacific Ry. on a tract of 1,300 acres where streets, sewers, water mains and industry tracks are being provided. Both the Wabash and the Santa Fé railways have acquired land for terminal improvements. The new 1,000,000-bushel grain elevator of the Missouri-Kansas-Texas Lines was enlarged for 250,000 bushels of additional storage at $400,000, while plans are reported for enlarging the elevators of the Missouri Pacific ($500,000), the Burlington and the Santa Fé railroads. The Missouri-Kansas-Texas Lines completed the new yard and engine terminal at Denison, Tex. ($3,300,000), and a new freight station at Houston.

A development of special character at Los Angeles is the establishment of the Central Manufacturing District, organized and planned on the same lines and by the same interests as that at Chicago. The Los Angeles district, which already has seventeen buildings, includes warehouses and manufacturing plants served by a joint or union station for l.c.l. freight and spur tracks from the independent belt line of the Los Angeles Junction Ry.; this line will connect the "district" industries with all the railroads entering the city and will have classification yards where the railroads will deliver and pick up their trains, the Junction Railway handling movements between these yards and the "district" freight station and industry tracks. At Los Angeles, also, the Southern Pacific is completing a large classification yard and other freight terminal facilities, while the Union Pacific has completed a freight terminal and is building yards and shops.

Reconstruction of freight terminals at Pueblo, Colo., has been made necessary by the new flood protection works. Here the Denver & Rio Grande Western R.R. will have one large yard in place of five old yards, and will also have a transfer or interchange yard. The Missouri Pacific, Santa Fé and Colorado & Southern will also carry out improvements. At Denver, the Rio Grande road has spent about $3,000,000 on new shops, yard revision, an automobile depot and a powerful electric gantry yard crane. The Burlington System spent $3,500,000 on its new shops and is spending $1,500,000 for a warehouse and team track facilities. The Union Pacific has completed its $2,000,000 freight station, yard and warehouse, and is developing an industrial district. At Seattle, Wash., where the entire railway terminal situation is under discussion, the Great Northern Ry. in 1924 built a terminal post-office station. At Portland, Ore., an outlying classification yard and engine terminal are being built by the Northern Pacific Terminal Co.

Marine Terminal Improvements

A general study of the situation shows widespread and extensive improvements under way and planned at ocean and lake ports. Besides work undertaken by the railways there is much being done by state and local authorities and by private enterprise, but in all cases railway connections and facilities are included.

North Atlantic Ports—At Portland, Me., the sheds are being enlarged on the State Pier and the Grand Trunk Ry. piers. Improvements in New York harbor will include the rebuilding of the Erie R.R. piers at Jersey City, destroyed by fire in November. At Philadelphia, the city is completing some municipal piers and plans others, representing a total cost of several million dollars, while 88 acres of the former U. S. Government terminal on the Delaware River are being converted into a lumber storage yard for the Tidewater Terminal Co. The Reading R.R. is building a $284,000 grain elevator at 20th St. to replace one destroyed by fire; it also has extensive works planned at Port Richmond, including a grain elevator, $3,000,000; ore dock and ore handling machinery, $915,000; and a car unloading and thawing plant with 120-ton car dumping machine, $1,650,000. At Baltimore in 1924 the Baltimore & Ohio R.R. completed a new grain elevator, pier galleries and track layout at $5,500,000; also a double-deck export pier 1,000 ft. long, $3,600,000.

At Norfolk, Va., large works have been undertaken and others under way or projected, though some of the last are as yet indefinite. The Virginian Ry. has built the coal shipping pier and car dumping plant described in *Engineering News-Record*, Sept. 18, 1924, p. 452, while the Norfolk & Western R.R. has enlarged its coal shipping facilities and has completed a series of freight piers and warehouses begun just before the World War and then taken over by the War Department as an engineer base. A waterfront terminal estimated to cost $5,000,000 is reported as under consideration by the Pennsylvania R.R. An unusual feature is the new municipal terminal established at a cost of $5,000,000 and including a pier, warehouse and 800,000-bushel grain elevator. This takes the place of the army supply base which was operated as a municipal terminal for some time after the War.

South Atlantic and Gulf Ports—Marine terminals to be built by a municipal bond issue are contemplated at Raleigh, North Carolina. At Charleston, South Carolina, the Port Utilities Commission has completed the Union Pier, 650x418 ft., on concrete piles and carrying two steel sheds each 580x135 ft., with four depressed tracks between them. The Commission has also improved the Adgers Wharf, of stone and timber construction, including two piers 450 ft. long with a 100-ft. slip between them. The Gulf Refining Co. is building a wharf 1,100 ft. long with warehouse capacity for 300,000 barrels. At Brunswick, Ga., the city expects to begin work in 1925 on municipal terminals and warehouses for which a bond issue of $1,400,000 is authorized, and the Atlantic Coast Line has spent $175,000 in improving its Brunswick River docks. Another municipal project is that of St. Petersburg, Fla., estimated to cost $1,500,000 for piers and harbor works.

At Mobile, Ala., the State Docks Commission has an extensive project for grain elevators and warehouses, with railway terminal and interchange yards and a belt line connecting with the several railroads. For this work the state has authorized the expenditure of $10,000,000. Work reported under way at New Orleans includes a municipal wharf on the industrial canal ($1,800,000), a wharf for the United Fruit Co. ($1,000,000), the Canal St. ferry house ($700,000) and the public coal landing plant ($100,000). The Illinois Central R.R. has improved its Stuyvesant Docks at a cost of $409,000, and the Southern Pacific is reconstructing levees, wharves and the car-ferry transfer. Farther up the river, at Baton Rogue, the Illinois Central is improving its docks and wharves at a cost of $350,000; while the city is planning similar improvements under a bond issue of $350,000 voted recently.

At Houston, Texas, which is an ocean port by virtue of its ship channel, the local Navigation District during

1924 built four wharf units aggregating 2,140 ft. in length, with three covered concrete sheds 480x150 ft., and an open wharf with railroad tracks; also a classification and assembling yard. The Public Belt R.R., owned by the city and the Navigation District, has extended its line and built connections to the wharf terminals. For 1925 the District proposes a 1,000,000-bu. grain elevator on the turning basin and also a concrete transit shed and steamship passenger terminal. At its Clinton docks, below Houston, the Southern Pacific Ry. has commenced work on a slip 1,200x225 ft., with piers, transit sheds and railway tracks, providing accommodation for six large steamers at an estimated cost of $969,000. Private interests have built an 800-ft. wharf with two-story brick and concrete warehouse, a two-story addition to the water-front cotton compress, a transit shed 1,750 ft. long, and a 400-ft. oil pier.

Pacific Coast Ports—At San Diego, Calif., the city is completing a pier 1,000x400 ft. at a cost of $1,250,000 and has voted bonds for building 3,000 ft. of bulkhead and reclaiming 80 acres of tide lands. For Los Angeles, the U. S. Board of Engineers for Rivers and Harbors has recommended a public belt line serving all railroads and the organization of a port district to carry out suggested harbor improvements. Reclamation of 75 acres of tidelands for municipal harbor facilities and an industrial district is proposed at Alameda, Calif.

At San Francisco there is active work under the Board of State Harbor Commissioners. During 1924, extensions to the grain cleaning plant at Islais Creek cost $80,000 and a reinforced-concrete subway to carry the Embarcadero under the foot of Market St. on the waterfront will cost about $400,000; this subway, to be completed by March, is 23x13 ft. for 380 ft. with two 300-ft. approaches on 3¾ per cent grades. New work for 1925 includes a six-story reinforced-concrete warehouse 813x102 ft. at China Basin, its width being increased to 134 ft. for the first story to form an elevated driveway approached by a ramp; the freight handling equipment will include elevators, spiral chutes and gantry and roof cranes. Bids have been received for the first two stories and the total cost will be about $1,250,000. Bids have been received also for Pier 50, opposite Mission Rock, 600x386 ft., with a wharf 800x60 ft., all having a reinforced-concrete deck on wood piles protected by precast reinforced-concrete jackets; the pier will have three depressed tracks in the middle and two surface tracks along each side. The estimated cost is $1,000,000, exclusive of the future transit sheds. Ultimately this pier will be doubled in size, extending to Mission Rock. There will be a trestle bulkhead, dredging and rock fill at Islais Creek to reclaim 25 acres of land for industrial purposes. This work, estimated to cost $220,000, will be followed by a 1,400-ft. pile and timber wharf.

At Portland, Ore., the Union Pacific Ry. is building a wharf at a cost of $370,000. The city's Public Dock Commission has built warehouses, has started the first unit of a 1½-mile sea wall along the water-front and is filling in land for new warehouses and docking facilities. At Tacoma, Wash., a lumber company has extended its pier to accommodate six more steamers.

Lake and River Ports—Most of the activity on Lake ports has been in connection with the coal and iron ore traffic. At Sandusky, the Pennsylvania R.R. will build a new car-dumping plant capable of handling forty coal cars per hour, costing nearly $800,000, while at Conneaut the Bessemer & Lake Erie R.R. will build an ore dock. At upper lake ports, the Soo Line is building at Ashland, Wis., a 60,000-ton ore dock of reinforced concrete on wood piles, which is to be ready for the 1925 season and will cost about $1,500,000. At Superior, Wis., the Great Northern Ry. is building a similar ore dock costing $2,000,000. The Chicago & Northwestern will build two new ore-docks of timber at Escanaba; one to replace an old dock destroyed by fire.

River straightening projects to improve rail and water terminal facilities at Chicago and Cleveland make little progress, but Chicago has now a project for the development of a harbor in Lake Calumet by the New York, Chicago & St. Louis Ry., which proposes to build a belt line and freight terminals in connection with the harbor works. A Chicago lake-front harbor and a barge terminal on the river are both projects which are as yet in early promotion stages. At Milwaukee, extensive rail and water terminals are planned in connection with the lake-front harbor now being established. Legislation authorizing the establishment of a port district at Detroit is being sought by the city, under an amendment to the constitution which permits the state legislature to create such districts.

Among inland river and waterway terminal projects, is a rail-and-water terminal, Cincinnati, providing better accommodation and freight-handling facilities than at the present paved levee, but the plan is still indefinite.

Canadian Ports and Terminals

In Canada, the larger projects appear to be at the ports. At St. John, N. B., plans are being made for a new union station with main approach from a viaduct across the tracks. In 1924 the city completed its new dry dock 1,150x125 ft., one of the largest in the world, with a middle gate forming two compartments 650 and 500 ft. long. A marine railway for the repair of smaller vessels was also built. The Canadian Pacific Ry. has extended its grain conveyor berths, and the Canadian Northern Ry. has plans for a terminal at the head of Courtenay Bay, including four piers and a grain elevator, work on which is expected to begin in 1925. Bids are reported as asked for a 1,000,000-bushel elevator at Halifax for the Canadian government. At Montreal, the city council is studying a vast city-planning project which includes a boulevard extending the whole length of the island and serving a reorganized system of railway terminals, warehouses, piers and grain elevators. These improvements would cost nearly $100,000,000. At Ottawa, a 2,000-ft. tunnel across the city is proposed as part of a city plan to revise the railway terminals, eliminate grade crossings and open new streets, but the railways are not yet prepared to accept this project. At Toronto, 1924 saw the conclusion of the protracted controversy over railway and water front facilities, so that a viaduct will be built costing about $30,000,000 and it is expected the new union station, which has been standing idle for some years, can be put in service by 1927. At Vancouver, B. C., port improvements of the three years 1923-1925 are estimated to cost $17,550,000. In 1924, there were completed a 1,500,000-bushel grain elevator ($1,500,000), two grain loading jetties ($600,000 each), and the 18,000-ton floating dry dock of the Burrard Drydock Co. ($3,000,000). Works planned for completion in 1925 include a Canadian Pacific Ry. pier, 1,100x350 ft. ($3,000,000) and three private grain elevators.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Trenton Will Again Readvertise for Sewage-Works Bids

The second set of bids for constructing sewage-works for Trenton, N. J., was rejected by a unanimous vote of the city commission on Jan. 2 and a decision reached to advertise the contract a third time. The action was taken on the advice of George A. Johnson and George L. Watson, consulting engineers, New York City.

The ground for the rejection of the second bids was alleged irregularity in the bid of the J. P. White Co., Passaic, N. J., the lowest bidder at the second bidding, and also in the bid of Joseph L. Sigretto, Bernardsville. N. J., who was the lowest bidder at the first bidding and next to the lowest at the second. The highest of the three bidders at the third bidding, Michael Staub and the Colyn Construction Co., of Trenton, claimed that its bid alone was legal. The city counsel ruled that the bid could be legally awarded to the highest bidder but that course seemed likely to result in litigation.

For further details see *Engineering News-Record*, Nov. 13, 1924, p. 806, and Dec. 4, 1924, p. 925.

License Issued for 460,000-hp. Plant on Susquehanna

The Federal Power Commission has issued a license to the Susquehanna Power Co. for the construction of a hydro-electric power plant on the Susquehanna River near Conowingo, Md. The plans call for a dam 3,680 ft. long and 103 ft. high in the spillway section across the river 4¼ miles above the head of navigation in the tidal section of the river above Chesapeake Bay. It will form a pool extending 13½ miles up-stream to the power plant at Holtwood and flooding 8.8 sq. mi. in Pennsylvania and 3.6 sq. mi. in Maryland. A considerable portion of the Columbia and Port Deposite line of the Pennsylvania R.R. will be flooded and will require relocation of the road at a higher level.

The power house and intake will be at the west end of the dam. The initial installation of generators will be six of a combined capacity of 280,000 hp. and provision will be made for four others which will bring the total installation up to about 460,000 hp.

Two 220,000-v. transmission lines 55 miles long will carry the power to Philadelphia where it will be sold to the Philadelphia Electric Co. Provision is made in the right-of-way for a third transmission line. The estimated cost of the project is $52,200,000. Due to the fact that the power is to be developed in Maryland but financed and sold in Pennsylvania, the Federal Power Commission, for the first time, has assumed authority over the financing, rates, and services.

Engineering Fifty Years Ago

From *Engineering News*, January, 1875

BUT what about the future of engineering? In answer we would ask our readers to trace out, on a map of the world, the countries whose people are familiar with the application of that most marvelous agent of civilization, steam. They are to be found on the continents of Europe and North America, and in number are less than half a score, while their total populations are but a fraction of the many millions of people who are awaiting the introduction among them of the great civilizer. To say nothing of the South American States and Mexico with their 40,000,000 of population, even Russia and Hungary are comparatively without railroads, and much less have these countries learned to employ steam in their various manufacturing processes, and now China, Japan, India, Brazil and other South American countries with their immense populations are showing a marked inclination to encourage internal steam transportation, while every careful observer of the indications of the present times can discern the signs of an awakening of a commercial spirit all over the world which ere long will break down the barriers of exclusiveness that have hitherto prevented the free intercourse of nations and a period of public improvements will be inaugurated, such as heretofore has been scarcely imagined.

Engineering is the science of civilization and must ever be in the van. The time is not far distant when the services of civil engineers will be greatly in demand. And while English, French and German engineers will largely control certain territories, yet to American talent there is a vast field open, and it behooves them to be ready to take advantage of each opportunity as it is presented. A little thought given to the subject will bring to their minds the many fields of enterprise that are open; let them see to it that, by study and investigation, they are prepared to respond to the call for their services, and by their works demonstrate their ability to add new honors to the noble profession which they represent.

St. Louis County to Vote on Bonds

Petitions are being circulated in St. Louis County, Mo., for the calling of a special election this spring to vote on the issuance of $7,500,000 county improvement bonds, of which $5,000,000 would be for roads, $1,500,000 for the erection of a new court house and jail and $1,000,000 for a hospital.

Toronto Approves $14,000,000 Water-Supply Project

By a vote of 2 to 1 the electors of Toronto, Ont., on Jan. 1 approved the general terms of a project for an additional water supply estimated to cost $14,000,000. Authority to issue bonds must yet be obtained either at a bond election or from the provincial legislature. The scheme includes a new lake intake, pumping and filtration plant in the easterly part of the city, at a distance from the present slow sand and drifting sand filter plants, on an island in the lake. The existing filters have a combined rated capacity of about 98 U. S. m.g.d., against a consumption of 84 U. S. m.g.

U. S. Ruling Taxes City Workers

Thousands of municipal employees hitherto classed as exempt from the federal income tax are liable to the tax according to a ruling of the Commissioner of Internal Revenue. Details will be given in a later issue. Employees of municipally-owned waterworks, railways, cafeterias run in connection with public schools, and also employees of port districts, are specifically mentioned as non-exempt under the Internal Revenue Act of 1921, which seems to be held retroactive. The context indicates that the ruling applies to employees of any municipal works or services which are private or proprietary instead of strictly governmental in character.

Surety Association Urges Joint Bonding Committee

Important action looking toward the elimination of the irresponsible contractor has been taken by the Surety Association of America. Copies of resolutions adopted by this organization have been sent representatives of other associations which have functioned with it in recent months on bonding problems through the Joint Conference Committee.

One resolution urges formation of a permanent joint conference committee to include representatives of the Associated General Contractors of America, the American Association of Highway Officials, the American Institute of Architects, the American Society of Civil Engineers, the Casualty and Surety Agents Association of America and the Surety Association of America.

A second resolution provides for appointment by the association of a contract bond committee to investigate such underwriting and report standardized practices; advocates organization of local surety agency associations where none exists; favors abolition of bid bonds, and certification by public accountants of financial statements wherever practicable.

Noel W. Smith Becomes Head of Government Road in Alaska

Noel W. Smith, formerly assistant to the general manager, Eastern Region, Pennsylvania R.R., and more recently special assistant to the Secretary of the Interior appointed to investigate and report upon the government-owned railroad in Alaska, has been appointed general manager of that railroad. Mr. Smith's preliminary report on the Alaska R.R. was abstracted in *Engineering News-Record*, Dec. 25, 1924, p. 1052. Mr. Smith succeeds Lt.-Col. Lee H. Landis, whose resignation became effective Nov. 10, 1924.

Mr. Smith was born at Williamsport, Pa., Dec. 25, 1869, and entered the service of the Pennsylvania R.R. as a student in telegraphy before going to college. Later he graduated from Lehigh University and re-entered the service of the Pennsylvania R.R. in 1893 as a rodman. Subsequently he became an assistant supervisor and then supervisor on various divisions and in 1907 became assistant to the principal assistant engineer, then division engineer of the middle division, and in 1910 superintendent of the central division.

Break in Retaining Wall Causes 19 Deaths at Alkali Works

By the breaking of a retaining wall which held the refuse dump from the chemical works of the Mathieson Alkali Works near Saltville, Va., the immediately adjacent Holston River was temporarily dammed and the upstream pond thereby formed overwhelmed several of the workmen's houses in the river valley and caused the death of 19 persons.

This plant, where alkali is produced, is located in a valley of a sharply curving river with precipitous banks on either side. Immediately across the river from the plant is a level area between the hill and the river which for 24 years has been used as a refuse dump. The liquid tailings from the plant containing a considerable amount of refuse solid matter are pumped into this muck pile and retained there by a rock-fill wall roughly semi-circular in plan to border the curving river and abutting against the mountain to form the side of the pool away from the river.

This retaining wall is of long standing, about 120 ft. in base width and about 72 ft. high. The material which fills the dump is semi-liquid and quickly deposits sediment so that there is never any considerable amount of hydraulic head against the wall.

The break in the wall took place about eight o'clock at night. As a result of the break a considerable amount of the wall sloughed out into the river carrying some of the sediment and some of the semi-liquid deposit behind it, to the extent that the river was dammed and with its swift current quickly formed the upstream pool which overwhelmed the houses located on the banks of the river below the plant but above the temporary dam. The dam so formed broke under the pressure of the pool in a few hours. The cause of the break has not yet been determined.

Chicago Held to 4,167 Sec.-Ft. Lakes Diversion

The injunction granted the United States to restrain the Sanitary District of Chicago from withdrawing more than 250,000 cu.ft. per min. (4,167 sec.-ft.) of water from Lake Michigan was sustained by the U. S. Supreme Court in a unanimous opinion rendered Jan. 5. It is provided that the injunction shall go into effect in 60 days "without prejudice to any permit that may be issued by the Secretary of War according to law." The full decision will be printed in *Engineering News-Record* next week.

In its opinion, prepared by Justice Holmes, the Supreme Court brushes aside the defense entered by the sanitary district and says that "probably the dangers to which the city of Chicago will be subjected if the decree is carried out are exaggerated, but in any event we are not at liberty to consider them here as against the edict of a paramount power." The authority of the United States is supreme over navigable waters, it holds, adding that there is abundant evidence that the level of the lakes has been lowered by excessive diversion. The diversion also violates the treaty with Canada, the opinion intimates. The decision refers to delays in the lower court, and holds that the rights of no parties have been denied.

Chicago Sanitary District's 1925 Budget $23,763,000

In the 1925 budget of the Sanitary District of Chicago, which makes provision for the expenditure of $23,763,000, some of the larger items are as follows: Pumping stations, $1,230,000; bridges, $2,733,000; regulating works for Great Lakes, $425,000; dredging Calumet River, $750,000; new concrete walls for main channel, $1,045,000; North Side intercepting sewer, $6,150,000; 39th St. conduit extension, $900,000; Southwest side intercepting sewer, $250,000; West Side treatment plant, $500,000; stockyards treatment plant, $100,000; North Side treatment plant, $3,220,000 under contract, $3,500,000 for remaining work; North Shore channel highway, $941,000; West and Southwest sides treatment plant sites, $500,000 each. Included in the budget are items for contracts let and pending and for those that may be taken up; for example, the item for regulating works for the Great Lakes indicates that the District stands ready to furnish money to build the works at any time its offer may require action.

During the year before last, of a budget of $13,700,000 about $4,500,000 was spent; in 1924 of $25,500,000 provided, $8,500,000 was spent. This year an expenditure of $10,000,000 may be reached.

Army Construction Conference to Draw Many Specialists

Nearly 200 engineers in various specialized fields, contractors, architects, transportation and labor experts, accountants, attorneys and construction supply men, named by associations in these lines, are expected to attend the construction conference called by Secretary of War Weeks to be held in Washington Jan. 16.

The conference will lay plans for a war-time construction and procurement policy for the War Department which will tie into its peace-time policy.

The program calls for addresses at the morning session by Secretary Weeks and Quartermaster General Hart explaining the objects, after which Col. W. H. Johnson, of the general staff, will outline the general construction mobilization plan for an hour. He will be followed by Francis Blossom, chairman of the Board of Review of Construction, and by Gen. R. C. Marshall, Jr., general manager of the Associated General Contractors of America and chairman of the executive committee named to prepare plans for the conference at a preliminary meeting last October. Before the noon recess, there will be discussions of the place of the architect and of the engineer and the transportation expert in war-time construction.

Coolidge, Hoover and Work to Address A. G. C. Convention

President Coolidge and Secretaries Hoover and Work are scheduled to make addresses before the annual convention of the Associated General Contractors of America which will be held in Washington Jan. 12, 13 and 14. Postmaster-General New, Senator Wadsworth of New York and Representative Madden of Illinois, chairman of the House appropriation committee, are among the speakers announced to appear at the annual banquet.

Divisional meetings during the convention will be addressed by Thomas H. McDonald, chief of the Bureau of Public Roads; and E. E. Hunt, secretary of The President's Conference on Unemployment, Department of Commerce. Gen. H. M. Lord, director of the Bureau of the Budget, is scheduled to address one of the general sessions.

The general program includes a number of addresses on important topics by men prominent in the construction industry, the speakers, with the exception of the public officials mentioned, being members of the association or of organizations closely allied in interest with it.

A number of important suggestions will come before the convention in the reports of committees, while the discussions will cover a wide range of topics. The membership at this meeting will vote on a proposal of the executive board to change the title of the organization to The Associated General Constructors of America.

Early reservations indicate an attendance of between 400 and 500 persons. All sessions of the convention will be held at the Washington Hotel.

John B. Lober, President of Vulcanite Cement Co., Dies

Helped Organize Portland Cement Association—Was Pioneer in Cement Manufacture

John B. Lober president of the Vulcanite Portland Cement Co., a pioneer in the manufacture of portland cement, one of the organizers of the Portland Cement Association and one of its first presidents, died Dec. 12. He had undergone a severe operation early in November but was recuperating satisfactorily until a few days before he died.

Mr. Lober was born in Camden, N. J., April 11, 1848, and educated in the public schools and Peirce Business College. He entered business in 1870 with the Philadelphia firm of Warren Kirk & Co., manufacturers of coal tar products. When after several years, E. Burgess Warren became the only remaining member of the original firm, he and Mr. Lober reorganized the company and continued the business as Warren, Lober & Co. until 1883. In that year the company was purchased by M. Ehret, backed by W. L. Elkins and P. A. B. Widener, and then took the name Warren, Ehret Co., with Mr. Lober president. Although organized as a roofing concern it soon branched into concrete work, particularly in sidewalks and floors. In view of its success in this line a consolidation proposal was offered it by the Vulcanite Paving Co. and accepted in 1890. Mr. Lober became vice-president of the consolidation, which retained the name of the Vulcanite Paving Co.

This concern, one of the largest of its kind in the country, used large quantities of imported German cement. There was no cement in the United States sufficiently uniform in character for use by the Vulcanite company, which had established a reputation for a superior quality of work. Business increased to such an extent that it became advisable for the company to manufacture its own cement. It acquired a tract in Warren County, N. J., containing a high grade of cement rock, and in 1894 its owners organized the Vulcanite Portland Cement Co., of which George W. Elkins became president, Dr. A. B. Bonneville, vice-president, and John B. Lober secretary and treasurer. A cement mill was erected which had two 40-ft. kilns and a daily capacity of 125 bbl.

From the beginning of the cement company Mr. Lober was its active manager. He recognized the need for a domestic cement which would be equal in quality to the best foreign brands. The first thousand barrels were rejected by Mr. Lober as not satisfactory, but thereafter the product met all the requirements of the Vulcanite Paving Co. and others engaged in similar business. In 1903 Mr. Lober resigned as officer of the paving company to become president of the Vulcanite Portland Cement Co., where he served actively until only two months ago.

Mr. Lober early recognized the possibilities of development of the portland cement industry in America and he foresaw the advantages of co-operation and mutual aid in bettering the quality and furthering the uses of cement. With these objects in mind he with some others called a meeting, the result of which was the formation in 1902 of the American Association of Portland Cement Manufacturers now the Portland Cement Association. Mr. Lober was made vice-president, and a year later, president, serving six years until 1909. After several terms as treasurer he became president again in 1912, serving three years more.

Attempt to Throw Tentative Ry. Valuation Into Courts Fails

The U. S. Supreme Court, in a decision rendered on Jan. 5, blocked the attempt of the Delaware & Hudson Co. to have the courts rather than the Interstate Commerce Commission fix the tentative valuation of the railroads of the country. The case was of unusual importance because if the D. & H. had been successful the whole matter of fixing tentative valuations of the railroad properties would have been subject to review by the courts and the resulting extended legal proceedings would have postponed the fixing of final valuations indefinitely.

The court in rendering its decision said that there was nothing to indicate that the Commission wilfully disregarded the law or that it will not consider all the matters set up in protest, and that the railroads must pursue the remedy provided by the statute and give the commission opportunity to take final action before asking interposition by the courts.

Ulen Signs $10,000,000 Contract with Greece

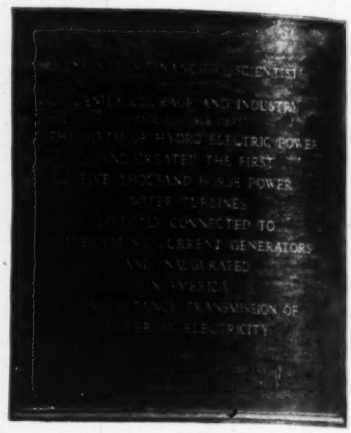
Ulen & Co., contractors with principal offices in New York City, has, together with the American International Corporation, signed a contract with the Greek government for water-works construction at Athens and the Piraeus, the work to cost in the neighborhood of $10,000,000. The contract is subject to ratification by the Greek Chamber, which convenes late in January. Major James F. Case, of the Ulen firm, carried on the negotiations for his company. Work will consist of a masonry dam, 40 km. of aqueduct and tunnels and extension and reconstruction of the existing water-distribution systems.

Fort Worth Adopts Manager Plan

The city manager plan was adopted at Fort Worth, Texas, on Dec. 11, by a vote of 7,076 to 5,530.

Niagara Power Tablet Unveiled

A tablet to mark the location of the first large scale hydro-electric power-development was unveiled at Niagara Falls, N. Y., on Jan. 3. It is located at the entrance of Power House No. 1, the building in which, thirty years ago, the world's first 5,000-hp. hydro-electric generators were installed. At that time three units with a combined output of 15,000 hp. were put into service. This year in a nearby power house three other units are developing 270,000 hp. and the total output on the American side is nearly a half million continuous horsepower.



TABLET MARKING FIRST LARGE HYDRO-ELECTRIC DEVELOPMENT AT NIAGARA

Cape May to Have City Manager

After defeats in four other New Jersey cities the voters of Cape May on Dec. 30 adopted the commission-manager plan authorized by the 1923 legislature. The vote stood 585 to 485. The present commission of three members will go out of office March 25 and be succeeded by five commissioners who will choose a manager. The four defeats of the plan occurred at Deal, Plainfield, Atlantic Highlands and Montclair.

Progress on the Moffat Tunnel

Daily progress on the six-mile railroad tunnel in the Rocky Mountains, fifty miles west of Denver, Colo., now averages 21 ft. in the headings of the pilot or water tunnel and the parallel main or railroad tunnel. In the enlargement of the latter headings to full section, the average progress is 30 ft. per day at the east end and 6 ft. at the west end, the latter requiring timber lining. This tunnel is being built by the Moffat Tunnel Commission; R. H. Keays, chief engineer; Clifford A. Betts, office engineer.

Up to Dec. 1, 1924, the total advance had been as follows:

	East Portal Ft.	West Portal, Ft.	Total, Ft.	Per Cent Finished.
Pilot tunnel	6,580	5,554	12,134	37.6
Main headings	6,384	4,730	11,114	34.5
Cross cuts[1]	260	260	520	40.0
Main tunnel (full size)	3,173	558[2]	3,731	11.6

[1] Cross cuts connect the two parallel tunnels.
[2] 989 ft. of sub-bench and 1,541 ft. of top widening finished.

John M. Diven, Secretary Emeritus, A.W.W.A., Dies

John M. Diven, secretary emeritus, American Water Works Association, and superintendent of water-works, Troy, N. Y., died at Troy on Jan. 4. He had been in poor health for three months past. Mr. Diven was born in Elmira, N. Y., in 1852. In the fall of 1872 he became secretary and treasurer and in 1883 superintendent of the Elmira Water-Works Co. Later on these water-works were consolidated with the local electric light and street railway systems under the control of the Elmira Water, Light & Railroad Co., of which Mr. Diven was secretary and treasurer. While he was with this company, the water-works were rebuilt and a filter plant was added, after plans by Mr. Diven, with Francis Collingwood as consulting engineer. From 1905 until 1912 Mr. Diven was superintendent of the Charleston (S. C.) Light & Water Co. From February, 1912, to Oct. 15, 1919, and from Jan. 1, 1924, until his death, Mr. Diven was superintendent of water-works at Troy.

Among thousands of water-works men, Mr. Diven was best known for his devoted services as an official of the American Water Works Association. He was secretary from 1889 to 1892; president in 1892-93; secretary from 1902 until Feb. 1, 1924, and secretary emeritus at the time of his death. Between his two period's of service at Troy, Mr. Diven was full-time secretary of the association, with headquarters in an office established by him in New York City.

Engineering Societies

Calendar

Annual Meetings

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 12-14, 1925.

AMERICAN ENGINEERING COUNCIL, Washington; Annual Meeting, Washington, D. C., Jan. 16, 17, 1925.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 21-23.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Montreal, Jan. 27-29, 1925.

AMERICAN WOOD PRESERVERS ASSOCIATION, Chicago, Ill.; Annual Meeting, Chicago, Ill., Feb. 3-5, 1925.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 24-27, 1925.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Convention, Chicago, Ill., March 10-12, 1925.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Louisville, Ky., April 27 to May 2, 1925.

The Louisiana Engineering Society will hold its annual meeting Jan. 10. Election of officers will precede a smoker.

The Detroit Engineering Society, together with the Detroit Section of the American Society of Civil Engineers, will discuss at its meeting Jan. 9, the relation of the Chicago drainage canal to the Great Lakes waterways project. The speakers include George H. Fenkell, William Livingstone, Gardner S. Williams, Capt. W. H. Adams, and C. W. Hubbell.

The Arkansas Chapter of the American Association of Engineers will hold its annual meeting at Little Rock, Ark., on Jan. 16 and 17. A bill for the registration of engineers has been prepared and will be discussed, in connection with which the Tennessee law regulating engineering practice will be described by Major A. L. Dabney, of Memphis. The fire-prevention work of the Underwriters Laboratory will be presented by George B. Muldaur, of New York.

The Western Society of Engineers has the following papers on its program for January: "Waterproofing Bridges," G. A. Haggander, bridge engineer, C., B. & Q. R.R.; "Super Power," R. F. Schuchardt, electrical engineer, Commonwealth Edison Co.; "New Type of Gas Storage Holder," A. S. Miller, Bartlett-Hayward Co.; "Automatic Substations at Steel Mills," G. P. Wilson, Westinghouse Electric & Mfg. Co.; "Appeals on Advertising," Morris W. Lee.

Personal Notes

FRANK M. CARHART has been put in charge of a new department formed by Jackson & Moreland, consulting engineers, Boston. The new department will be devoted to investigations and reports of a special nature, such as appraisals and rate studies, organization and personnel matters.

W. L. CHURCHILL has been appointed chief engineer of the Kansas City, Mexico & Orient Railroad Co., Kansas City, Mexico & Orient Railway Co. of Texas, and Kansas City, Mexico & Orient Ry. (in Mexico). He succeeds S. Buffington, who recently died. The appointment became effective Jan. 1.

JOHN W. BARNES, builder and engineer, and RAYMOND D. RITCHIE, builder, announce their association under the firm name of Barnes & Ritchie, builders and engineers, with offices at 10 East 43rd St., New York.

R. P. FAIRBAIRN, for the past fifteen years deputy minister of public works for Ontario, Canada, has resigned. Mr. Fairbairn entered the service of the Ontario Public Works Department forty-five years ago upon his graduation from college. He has been in the service continuously since. S. L. SQUIRE, deputy minister of highways, has been appointed deputy minister of public works, the two offices being consolidated.

G. W. SACKETT, for the past year and a half in charge of building waste-disposal plants for the Duquesne Slag Products Co. in the Pittsburgh district, has joined the staff of Ulen & Co., New York, as general superintendent of construction. Mr. Sackett is a former engineer and superintendent for Mason & Hangar on the construction of Charleston port terminals and the animal embarkation depot for the War Department, and engineer and superintendent for the Atlantic, Gulf & Pacific Co. on dredging port terminal channels also at Charleston. Prior to that time he was with the U. S. Engineer Department in charge of surveys, estimates, dredging and jetty design in one of the district offices and chief engineer and general superintendent for the Hillsboro Dredging Co. on levee construction work on the Mississippi.

W. G. SWAN, who has for five years been chief engineer of the Vancouver Harbor Commission, Vancouver, B. C., and in that capacity has supervised the design and construction of extensive pier and terminal facilities in that port, has resigned effective Jan. 31 and will then serve as consulting engineer for this commission. Mr. Swan has also been retained as consulting engineer by the Harbor Board of the city of New Westminster, which has under way further port improvements in the Fraser River.

H. J. HARDER, city engineer of Paterson, N. J., since 1900, has been transferred, at his own request, by the Board of Public Works, from the position of city engineer to that of resident engineer to represent the city in carrying out a contract with the Erie Railroad Co. to eliminate the grade crossings within the Paterson city limits. Mr. Harder made the original plans for the elimination of these crossings in 1914, but work was not started until 1924, and it is estimated that seven years will be required for its completion.

CHARLES F. STOUT, surveyor for Blair County, Pennsylvania, has been elected as county engineer for Blair County to succeed David A. McCloskey, resigned, the latter leaving on Jan. 1 for Ocala, Fla., to enter a partnership with E. A. Morehead.

Obituary

FRANK B. SOUTHWICK, one of the oldest contractors in Oregon, died Dec. 24, 1924, at his home in Salem, Ore. Mr. Southwick went to the Pacific Coast in 1882 and located in Salem. During the past forty years he built many large buildings for the state of Oregon and also for private enterprises in Salem, in the state, and in adjoining states.

WILLIAM FARRIS, president of the Farris Bridge Co., Charleston, W. Va., died at his residence in Mineral County, W. Va., Dec. 12. Mr. Farris received his education at Northwestern University, and had engaged in engineering and construction work during the last twenty-five years.

ROBERT F. H. BRUCE, formerly superintendent of the Ottawa River Works and civil engineer on the old Canada Atlantic Ry., died recently at his home in Ottawa following a brief illness; he was 59 years of age. Mr. Bruce was born in Londonderry County, Ireland, and went to Canada 25 years ago.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Census Figures Show Size of Paving Materials Industry

The Department of Commerce announces that, according to data collected at the biennial census of manufactures, 1923, establishments engaged primarily in the manufacture of paving materials reported products valued at $71,648,660, an increase of 17.2 per cent as compared with 1921, the last preceding census year. This industry classification covers establishments whose principal products are paving blocks (including granite but not including other forms of stone) and paving materials of all classes, mixed and unmixed, for streets, sidewalks and floors.

In addition, paving materials were manufactured to some extent as secondary products by establishments engaged primarily in other industries. The value of such products thus made outside the industry proper in 1921 was $2,797,639, an amount equal to 4.6 per cent of the value of products reported for the industry as classified. The corresponding value for 1923 has not yet been ascertained but will be shown in the final report of the present census.

In 1921, the industry was represented by 653 establishments. A decrease to 626 in 1923 was the net result of the loss of 85 establishments which had been included for 1921 and the addition of 58 which had not been classified in this industry for that year. Of the 85 establishments lost to the industry, 21 had gone out of business prior to the beginning of 1923, 28 were idle during the entire year, 34 reported products valued at less than $5,000 (no data are tabulated at the biennial censuses for establishments with products under $5,000 in value), and 2 were engaged in the manufacture of products other than paving materials in 1923 and were therefore transferred to the appropriate industries. Of the 58 establishments not previously classified in this industry, 55 were new to the census and 3 manufactured other products than paving materials in 1921.

The statistics for 1923 and 1921 summarized in the accompanying table are preliminary and subject to correction.

MANUFACTURE OF PAVING MATERIALS, 1923-1921

	1923	1921	Per Cent of Increase (a)
Number of establishments	626	653	—4.1
Wage earners (average number) (b)	19,442	15,387	26.4
Maximum month	Aug. 22,837	Aug. 18,810	....
Minimum month	Feb. 14,063	Jan. 10,290	....
Per cent of maximum	61.6	54.7	....
Wages	$22,108,859	$17,284,903	27.9
Cost of materials	$24,841,561	$24,473,607	1.5
Products, total value	$71,648,660	$61,128,969	17.2
Value added by manufacture (c)	$46,807,099	$36,655,362	30.0
Horsepower	197,588	(d)	....
Coal consumed (tons of 2,000 lbs.)	542,409	(d)	....

(a) A minus sign (—) denotes decrease.
(b) Not including salaried officers and employees nor proprietors and firm members. Statistics for these classes will be given in final report.
(c) Value of products less cost of materials.
(d) Not reported.

Slate Producers to Meet

Slate and its uses will be considered in all phases at the annual Slate Industry Conferences, held under the auspices of the National Slate Association at the Hotel Commodore, New York, January 19-20, 1925. These conferences are not restricted to members of the National Slate Association, but include all engaged in the production, sale or installation of slate.

Road Show and Convention Reports Next Week

To those engineers and contractors who could not be in Chicago Jan. 5-9, next week's issue of "Engineering News-Record" will bring the complete story of the American Road Builders Convention, as told by two of its editors.

Charles S. Hill will cover the technical proceedings at the Congress Hotel, while Robert K. Tomlin, Jr., will send back details of the new and improved machinery at the big equipment exhibit in the Coliseum.

Business Notes

MILWAUKEE CORRUGATING CO., Milwaukee, Wis., which in 1923 added 50,000 sq.ft. of floor space to its factory and also took over a plant formerly belonging to the Gund Brewing Co., at La Crosse, Wis., has recently started work on a two-story extension, 200 ft. back of the main plant in Milwaukee. This extension, as planned, will be completed within sixty days and will add 100,000 sq.ft. of floor space.

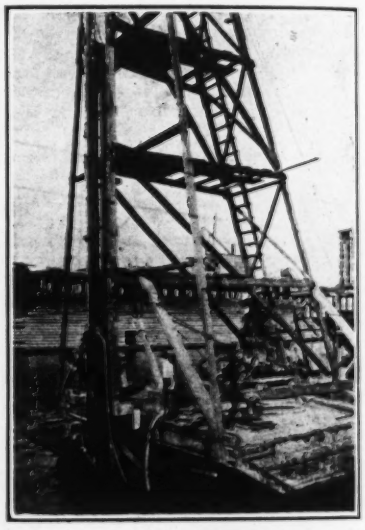
JEAN M. ALLEN & CO., engineers and contractors, announce the removal of their offices from Chicago to the Maison Blanche, New Orleans, La., but they have arranged with the Bates Engineering Works, Chicago, to continue the manufacture of the Allen company's line of hydraulic dredge specialties, ladders, cutters and hoists.

Equipment and Materials

Steam Hammer Drives Piles Under 80 Ft. of Water

An application of a steam hammer to submarine pile-driving at an unusual depth under water has been made in connection with the foundations for the Burnside bridge across the Willamette River at Portland, Ore. The water is 80 ft. deep at the bridge site and the river bed consists of sand and coarse gravel. The piling specifications call for a minimum of 12 in. in diameter at the small end. To have used full-length piling would have required a length of from 110 to 120 ft. while the use of shorter piles with followers was considered impractical on account of the hard driving.

The method finally adopted by the contractor, the Pacific Bridge Co., was



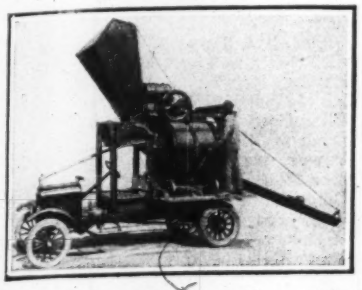
Steam Hammer Guided Under Water by Telescopic Leads

to rig a McKiernan-Terry submarine pile hammer in vertical leads 70 ft. long which telescoped into main leads 110 ft. in length, mounted on a barge; 40 ft. of the main leads were submerged in water and the telescopic leads carrying the hammer were extended down to the river bottom. Piles 40 to 50 ft. long were driven by the hammer, while entirely submerged, until their tops were about 10 ft. above river bottom.

For each of the two bascule bridge piers, 68x78 ft. in area, approximately 400 piles were driven to a penetration of from 25 to 32 ft. According to the contractor's records, the progress of the work showed an average of 18 piles per 7½-hour shift.

Ford-Mounted Mixer Has Improved Details

On the latest model of its Speedmobile, consisting of a one-bag concrete mixer mounted on a 1-ton Ford truck chassis, the Archer Iron Works, Chicago, has improved several details of



design. All gears and shafts running above 150 r.p.m. are inclosed in gear boxes and operate in oil; Hyatt or Timken roller bearings also are provided for shafts running above the speed noted. The design of the unit provides for all-steel construction and the weight is less than a truck equipped with a body and hauling a 1-ton load. By means of a special power take-off, the Ford engine rotates the mixer drum and operates the loading skip. This portable mixer is recommended by its manufacturer for small road work, street paving, gutters, culverts and bridge work, in which the mobility of the outfit may be used to advantage.

Bin Has Four Sloping Sides to Reduce Dead Storage

To reduce dead storage the Erie Steel Construction Co., Erie, Pa., has brought out a new type of overhead bin designed with four sloping sides and built in sizes to hold 85 and 115 tons. The bins are particularly adapted to the loading of motor trucks or for use at central concrete mixing plants.

These bins may be equipped with the company's Aggremeter boxes for measuring correctly batches of sand, gravel or broken stone. The latest design of these boxes permits the operator to see when they are filled without depending upon indicators. The measuring boxes are of the telescopic type, the sand box having an adjustment of from 6 to 13½ cu.ft. and the stone box from 12 to 24 cu.ft. Any size batch between these limits can be had.

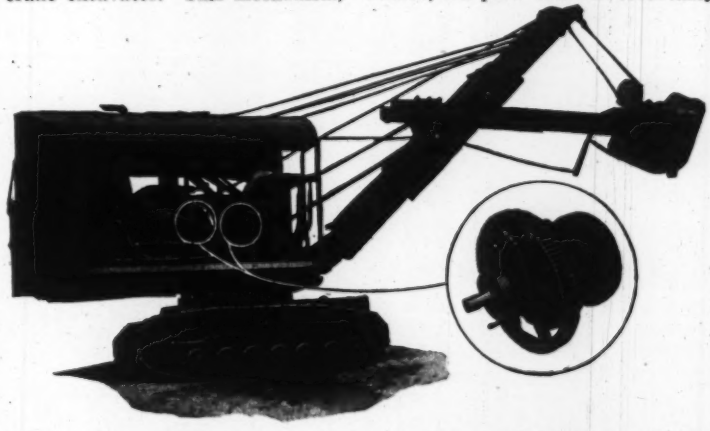
Annual Equipment Review Postponed Until Spring

"Engineering News-Record's" Annual Review of Construction Machinery, formerly a feature of the first issue of the new year, will henceforth be published in the early Spring.

Two reasons justify the change: appearing at the opening of the construction season, when contractors and engineers are ready to make purchases of construction plant, the Review will gain in timeliness and general interest. Also, the later date of publication will avoid conflict with the report of the Good Roads Show, held in Chicago in January, and will make it possible to cover in the Review the new or improved features of machines and materials exhibited in the Coliseum.

Power Clutch Control Device for Shovel Excavator

A new clutch control device, operated by power from the engine, has been applied by the Pawling & Harnischfeger Co., Milwaukee, to its shovel and crane excavator. This mechanism,



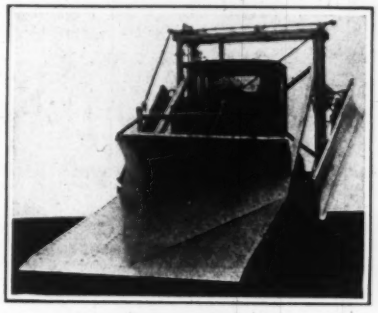
minimizing physical effort on the part of the operator, consists of a small auxiliary brake with attachments causing the power of the motor to operate the main drum clutches. When the spur gear is rotating, the drum clutch, clutch-operating arm and drum all rotate with it. The auxiliary clutch band is stationary, the dead end being fastened to the machine frame and the other end to the operating lever.

When the operator pulls the lever towards him, the auxiliary clutch band is tightened about its drum, retarding the rotation until the clutch-operating arm has been rotated sufficiently to cause the main clutch to grip the drum. The average pull required to operate this control device is about 4½ lb. There are only a very few moving parts and the whole operation is simple. There is very easy accessibility for lubrication and adjustment.

This new clutch control will be known commercially as the power clutch control.

V-Type Snow Plow Equipped With Side Wings

For attachment to a 10-ton crawler tractor, the Good Roads Machinery Co.,



Kennett Square, Pa., has designed a V-type snow plow with side wings capable of clearing a 17-ft. path. The plow is intended for work in heavy masses of snow and is designed for attachment either to tractors which will permit of carrying the plow direct, such as the Linn, or to tractors which draw the plow, such as the Holt. On the latter the plow and wings are supported on auxiliary runners.

As shown in the accompanying illustration, the plow consists essentially of an inclined platform, above which is a V-shaped moldboard 8 ft. wide and 5 ft. high. The inclined platform lifts the snow, enabling the moldboard to roll it upward and sideways. By means of a worm-and-gear lifting device, the plow is raised 12 in. from the ground.

Behind the moldboard, on either side are blades or wings 30 in. high and 12 ft. long. These also may be raised, lowered, and clamped in any desired position. The plow is about 25 ft. long overall, 12 ft. high, and weighs 7,000 lb. for the models on runners, and 5,300 lb. for the model carried by the tractor.

With the V-shaped type of plow, the manufacturer states, the snow drift is bucked head on, without causing any side-draft on the tractor.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Large Projects In Prospect

The following represent just a few of the big engineering construction jobs on which bids are asked or will soon be called for. Further details are given in the Construction News section of this issue, pp. 11 to 23.

Proposed Work

Dam, Los Banos, Calif., for San Joaquin River Water Storage Dist., $18,000,000.

Water-works, Toronto, Ont., bonds voted, $14,000,000.

Irrigation project, Texas, State Board of Water Engineers, Austin, $9,000,000.

Water system, Albany, N. Y., appropriated $200,000 for surveys, total cost $6,000,000.

University group, Durham, N. C., for Duke University, $6,000,000.

Sewage treatment plant, Akron, O., bond sale Jan. 28, $3,000,000.

Engineering News-Record's annual statistics of the construction industry appear on pp. 79 to 85 of this issue. They are grouped as follows:

A New Table of Index Numbers of Construction Volume

IMPROVED METHOD of presentation. Recomputed index figures for last twelve years tabulated.

E. N.-R. Construction Cost Index—Derivation and Values

Spring Prices of Construction Materials Since 1913

SIXTH PUBLICATION of this tabulation with interpretation.

Price Outlook for Materials

Outlook for Labor Rates and Employment

TRENDS IN twenty cities.

Value of 1924 Contracts Break All Records

Engineering News-Record figures exceed $2,000,000,000 in United States alone.

Jail, Detroit, Mich., Wayne County, $3,500,000.

Plant, Brockwayville, Pa., for Bradford Brick and Tile Co., $2,000,000.

Paving, Milwaukee, Wis., Comr. Pub. Wks., $2,500,000.

Filtration plant, Knoxville, Tenn., making preliminary surveys, $2,500,000.

Power plant, Dallas, Tex., Dallas Power & Light Co., $2,500,000.

Office building, Ottawa, Ont., Metropolitan Life Ins. Co., $2,000,000.

Highway Metropolitan Dist. Comm., Boston, Mass., $2,000,000.

Tunnel, Portland, Ore. to Mahlan Valley, $2,000,000.

Theatre, Oakland, Calif., S. Grauman, $2,000,000.

Theatre, Philadelphia, Pa., Stanley Co. of America, $2,000,000.

Electric railway, Birmingham, Ala., Birmingham Electric Co., $2,000,000.

Bids Wanted on Big Jobs

Clubhouse, Boston, Mass., B. P. O. E., $3,000,000.

Hotel, Dallas, Tex., Dallas Hotel Co., $1,000,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of January 1, the next on February 5.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montrea
Structural shapes, 100 lb.	$3.34	$3.90	$4.15	$3.10	$3.35	—$3.07½	$3.00	$3.35	$4.25
Structural rivets, 100 lb.	+4.25	4.45	4.75	—3.50	3.75	4.65	5.00	3.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.24	3.40	3.38	2.60@3.00	3.25	3.97½	3.35	3.25	4.00
Steel pipe, black, 2½ to 6 in. lap, discount	44%	54.2%	43%	—56½%	55.45%	36%	44.7@55.5%	45%	37.83
Cast-iron pipe, 6 in. and over, ton	55.60@56.60	56.00	56.00	47.20@48.20	55.50	64.00	53.00	65.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	—2.10	2.42	2.84	—2.31	2.65	1.80
Gravel, ¾ in., cu.yd.	+2.25	1.90	2.38	3.00	1.65	1.90	2.15	1.50	1.25
Sand, cu.yd.	+1.25	1.40	2.00	3.00	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.00	2.83	3.00	1.75	2.50	2.15	3.00	2.25
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	58.00	34.00	—56.00	55.00	39.75	—39.75	29.00	26.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	23.00	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl.	2.50@3.00	1.45	1.85	—1.26	1.35	2.70	1.60	2.80	10.50
Common brick, delivered, 1,000	18.00	10.50	—11.60	12.00	15.00	12.00	14.50	14.50	17.50
Hollow building tile, 4x12x12, per block	Not used	.1004	.0941	—.06	.07	.085	.....	.11	.12
Hollow partition tile 4x12x12, per block	.1162	.1004	.0941	—.06	.....	.085	.108	.11	.10
Linseed oil, raw, 5 bbl. lots, gal.	+1.18	+1.26	+1.30	+1.25	+1.27	—1.38	+1.24	1.12	1.11
Common Labor:									
Common labor, union, hour	.75	.30	.....	.82½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	—.30@.50	.75	.50@.55	.35@.50	.50	.50	.25@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers, 75c.; excavating laborers, 62½c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; lump finishing lime per 180-lb. net. Lumber, sand, gravel and stone delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.60 for Kelly Island and Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.